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REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

With SPECIAL REPORT on ATTACK of CATERPILLARS of the DIAMOND-BACK MOTH,

DURING THE YEAR 1891,

WITH METHODS OF

PREVENTION AND REMEDY.

FIFTEENTH REPORT.

(L.C. Cds. Dnd 6-18-64)

BY

ELEANOR A. ORMEROD, F.R.Met. Soc., &c.

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PREFACE.

The past year has been remarkable for presence (more or less) of most of our common farm and garden insect pests, and also for bad attacks of several kinds of which the habits and means of prevention had been little recorded previously. To give the long list of infestations regarding which inquiries were received, would be for the most part a mere enumeration of our best known insect pests, as Wireworms, Daddy Long-legs, Carrot grubs, &c.; but so far as I could judge by the reports sent to myself, there was a remarkable difference in amount of presence of some of our very commonest attacks. Some were present to an unusual amount, some unusually absent.

Amongst corn attacks little was reported of Gout Fly (*Chlorops*), though it was mischievous to some degree; and very little either of Corn Sawfly, or Hessian Fly; or of the deformed growth in Oat plants, known as "Tulip-root," caused by presence of "Stem Eel-worms." On the other hand Wheat-bulb maggot was prevalent and injurious to a serious extent; Corn Aphis was more than usually reported, and a few attacks were observed of the malformation of grains in Wheat-ears, popularly known as "Purples," or "Cockle-galls," which are due like "Tulip-root" to the presence of Eel-worms, though of a different species of *Tylenchus*.

The Mediterranean Flour Moth (see pp. 46—52) continues to spread its destructive presence in Wheat-flour mills and stores, and since my paper on the subject has passed through the press, I have been favoured from Dr. Charles Lindeman (the well-known authority on agricultural Entomology in Russia) with information of the pest having been discovered in a locality in Moscow, to which it had been imported from London in infested sacks.

Reverting to attacks on the growing crops. Amongst Turnip infestations the very common attacks of Flea Beetle, Surface Caterpillars, and Turnip Aphis, were less reported than is often the case. On the contrary; Turnip and Cabbage-root maggots were very injurious in various places. Turnip-seed and Turnip

Flower Beetles were well brought forward (see pp. 96—105), and attack of the caterpillars of the Diamond-back Moth was only too notably present.

Mangold-leaf Maggot was most unusually prevalent, and Mangold or Beet Carrion Beetle (an excessively rare infestation on crops in England) was once again present, though only to a slight extent. Celery-*stem* Fly was another rarely observed infestation.

Amongst fruit attacks the injuries caused by the caterpillars of the Apple and Plum Sawflies to the growing fruit, were infestations which have been little brought forward before. Raspberry attacks were also severe in various localities last year, and Mite-galls of the Black Currant continued to be a serious cause of loss to growers.

The success of the treatment adopted at Toddington and various other places for destruction of various kinds of "Orchard Caterpillars" by use of Paris-green sprayings, or by use of Paris-green, and also of sticky-bandings, will be found under heading of Orchard Caterpillars.

The remarkable and very injurious attack to Strawberry growth which appeared in 1890 in Kent, causing a malformation of the plant, but especially of the flowering portions, until, from the swollen and stunted appearance, they assumed the form of small Cauliflowers, has been little noticed in the past season.*

* This was caused by the presence of Eel-worms of species previously unrecorded, of the genus *Aphelenchus*, and named by Dr. J. Ritzema Bos, of Wageningen, Holland, to whom I forwarded specimens, appropriately as the *Aphelenchus fragariæ*. Under this name Dr. Ritzema Bos has published various minute scientific papers on the subject, one entitled "De bloomkoolziekte der Aardbeiten," and in his papers, and my more popular notice in my '14th Report,' we have adopted for the popular name that of "Cauliflower disease" of the Strawberry. Thus we follow the well and long known English, foreign, and American plan of naming forms of plant disease arising from Eel-worm presence, from their altered appearance, as "Tulip-root," Pine-apple disease, Root Knot, &c. Since the publication in our respective papers of the record of our observations (in which I had the honour of working with, I believe, I may say the highest authority on this branch of nematode observations), much of this information has been given by Dr. N. A. Cobb, at pp. 390—393 of the number for July, 1891, of the 'Agricultural Gazette' of New South Wales. The authorship is duly acknowledged, but very unfortunately the name is altered by Dr. Cobb to "Strawberry Bunch." Therefore as "bunch" conveys no definite meaning, and "Cauliflower disease" conveys the appearance excellently, I have thought it permissible (after consultation with Dr. Ritzema Bos) to draw attention to it being undesirable to change a name carefully given on accepted long-standing principles by the original observers; thoroughly acquiesced in by growers; and established in scientific treatises of three nations, for one bearing *no distinctive meaning*.—Ed.

Serviceable advance continues to be made (by means of practical field observation) in knowledge of habits of both crop and fruit insects, which enable us to bring their attacks under the power of preventive measures practicable at a paying rate; and besides increased information of measures which can be brought to bear in ordinary course of husbandry, we have advanced in knowledge regarding useful insecticides and implements for their application.

Personally (as in each previous year) I desire to offer my sincere and cordial thanks to the many good friends, both in this country and wide-spread over the world, who have again assisted, not only by the definite help recorded together with the observations in which they have aided me, but also by much kind encouragement.

To the agriculturists of this country, and also to our Agricultural press, and to much of our general press also, I am greatly indebted, and I think none of them will differ from my own full belief (often expressed) that the greater part of such value as my yearly Reports may possess is as the record of the sound observations which I have now so long had the honour of receiving for publication year by year, and which I trust I may still be favoured with.

Of the wood engravings, those at pp. 11, 58, 96, and 105, are given by permission of Messrs. Blackie & Son, of Glasgow; the moths with wings extended at pp. 66 and 69, by permission of Messrs. Allen & Co. The moth in act of walking at p. 66 is after Dr. Taschenberg. Of such of the other figures as are partly taken from published authorities, the source is acknowledged beneath the figure, or in the letterpress on the same page. The remainder are from drawings made for my own publications by Mr. Horace Knight, artist to Messrs. West, Newman & Co., or in some few instances from my own drawings.

Just a few lines may appear to be called for to explain the great length of the report on attack of "Diamond-backs." So far as I can judge from reports sent me, or from research in previous records, this outburst (taken as a whole) was unexampled in this country, and I have endeavoured, to the very best of my power, to preserve its history accurately. To make this of value for reference, whether entomological or agricultural, it has seemed to me necessary to have certainty of the nature of the attack as far as possible *in every case recorded*, and of effects

of treatment not merely on the scale of experiment, but of results of applications to the broad areas of Turnip land reported along the infested country.

It may most truly be said of this attack that it involves unusual amount of meteorological and botanical considerations, as well as those customarily found in the attacks of crop insect pests. Therefore for those who care to study the points in detail, the reports with which I have been favoured are laid before them; but for other readers the "General Summary" appended gives, so far as I am able, a condensed view of the main points.

ELEANOR A. ORMEROD,

Honorary Consulting Entomologist of the Royal Agricultural Society of England.

Torrington House, St. Albans,

February, 1892.

LIST OF

ATTACKS OF INJURIOUS INSECTS, OR INSECT ALLIES,

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NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

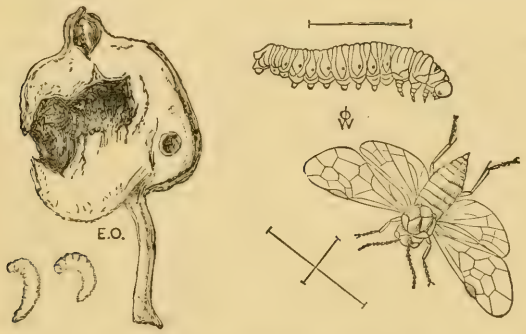
AND

COMMON CROP PESTS

DURING 1891.

APPLE.

Apple Sawfly. *Tenthredo* (*Hoplocampa*) *testudinea*, *?* Klug.*



TENTHREDO (HOPLOCAMPA) TESTUDINEA.

Female Sawfly and caterpillar, magnified, with lines showing nat. size, after Prof. J. O. Westwood; † caterpillars nat. size, and infested Apple.

ATTACK of Apple Sawfly caterpillars has not been much reported up to the past season, but from last summer's observations it seems probable that this infestation is more prevalent than is commonly

* From the appearance of the caterpillar of the Apple Sawfly, and likewise from its habits and the characteristics of the attack, it scarcely appears open to doubt that it is the larva of the *Tenthredo* (*Hoplocampa*) *testudinea*, Klug; but as we have not as yet reared the perfect insect (the time not being yet come for its development from our specimens), I give the scientific name with a note of interrogation.

† See 'Gardeners' Chron.' vol. for 1847, p. 852.

supposed, only not generally recognised owing to there being many points of resemblance between this attack and that of the caterpillars of the Codlin Moth.

Apple Sawfly attack has long been known to be present in this country. So far back as 1847 this infestation was described, from his own observations, by Prof. J. O. Westwood; but it was not until the past summer that I had an opportunity of observing the method of attack myself, and with the assistance of Mr. W. Coleman, of Cranfield, Beds, making out some points in the history of the caterpillar which (so far as I am aware) have not been previously noticed.

On June 24th, Mr. Coleman sent me specimens of injured Apples, with the remark:—"The young fruit of the Apple is being again subjected to wholesale destruction in my orchards, by a grub which pierces the young fruit when about the size of a small bean up to a cob-nut. I have not seen any larger affected; when they get beyond this cob-nut size they appear to be safe from attack."

The little Apples forwarded to me were injured in a manner that might have been caused by Codlin Moth caterpillars, but no caterpillars of any kind were then present in them, and Mr. Coleman mentioned that those he had found differed from those of the Codlin Moth in various points specified.

On June 29th, according to my request, Mr. Coleman forwarded me some caterpillars for examination, with the remark that the attack had extended all over the orchard, and seemed likely to clear most of the fruit. On taking these grubs out of the quill in which they were sent, I noticed a smell just like that of a plant bug, or common bed bug, which at once suggested a species of Sawfly caterpillar was present, and on examination I found that, besides three pairs of claw feet, and likewise a pair of sucker feet beneath the tail, they possessed six pairs of sucker feet beneath the body. Consequently they were quite certainly not Codlin Moth, but Sawfly caterpillars, and of these the largest specimens agreed with the description of the caterpillars of the Apple Sawfly (the *Tenthredo testudinea* of various writers) given by Prof. J. O. Westwood.

Presently, that is, on July 11th, when I had had the opportunity of examining caterpillars of various ages, I found that those in the earliest stages of which I had specimens differed from the larger ones in having shining pitchy or black heads, and the markings above the tail being also pitchy or black; and as, in case this change of colour in moulting has not previously been recorded, it is of a good deal of practical importance, I give my own notes just from the specimens sent, followed by Mr. Coleman's careful reports, up to absolute observations of the moult of the black-marked head and tail, and appearance from within of the caterpillar as usually previously noticed.

On July 11th the Apple Sawfly caterpillars sent me, apparently full grown, length between three-eighths and half an inch, were whitish or creamy in colour, head pale chestnut, eyes black, jaws dark brown in front, plate above tail, and cross band immediately preceding, mottled with grey. Three first segments each with a pair of jointed legs; fourth segment without appendages; fifth to tenth segments each furnished with a pair of sucker feet somewhat like blunt tubercles, tail segment also furnished with a similar pair, not so noticeable, however, excepting when in the act of walking, the caterpillar or larva thus possessing twenty feet in all.

In the early stage (that is, in the case of specimens a little more than one-eighth of an inch in length) the head was shining pitchy or black; the plate above the tail was also shining pitchy or black, and immediately preceded by one cross band of similar colour, and this again by two narrower and shorter streaks, also black or pitchy. The black tail plate and the preceding band sometimes formed one mass.

The claw legs were darker than in the older specimens; the abdominal sucker feet were difficult to count in these very little specimens, which were somewhat shrunk in transmission, but by careful pressure in fluid, and with the help of a two-inch object glass, I was able to expand them so that there appeared no doubt all six pairs were present.

The small Sawfly caterpillars, black or black-marked at head and tail, and the larger and pale-marked caterpillars, were presumably of the same species; but I was indebted to Mr. Coleman for proving the point by direct observation of the pale-marked caterpillar leaving behind it the black-marked skin, and by his favouring me with the following notes.

A section of a fruit containing a caterpillar, with black head, &c., three-sixteenths of an inch long was placed under a glass. On the following day it had considerably increased in size, still feeding on the fruit (black head, &c., still noticed), and on the next following morning, July 1st, the black head or collar and tail had given place to the pale colour, and the grub had left the fruit and was travelling round the rim of the inverted glass. On examination of the Apple on which the grub had fed, in its successive black-marked and pale-brown-marked conditions, Mr. Coleman noted, "There were, clear enough, the black helmet, tail piece, and skin, shed within the Apple."

Mr. Coleman observed the grubs in stages of growth from less than one-eighth up to three-eighths of an inch long, always with the same number of feet (thus showing there was no confusion of the little creatures with the caterpillars of the Codlin Moth), and found that the black helmet and tail piece were shed with the skin at a certain period, giving place to the pale brown. Evidence of this was plain by the

remains of the first coat being found moulted off, and heaped up in the burrows, in several specimens of the fruit gathered from the trees.

Mr. Coleman found two and even three caterpillars in one fruit; also that even before they left the fruit, for their change to the chrysalis state, they were *by no means necessarily stayers at home.* On July 1st, "the morning being damp and showery," Mr. Coleman found "the grub in all positions, both black and pale heads and tails; some hanging half out of the fruits; some apparently taking their departure on the foot-stalk of the leaves near to a fruit; and two days after, a full-sized specimen (half an inch long) was taken from a perfect fruit, into the side of which it had not, when extracted, eaten its full length."

I had the opportunity myself of seeing the operation of the caterpillars, after leaving the Apples, burying themselves in the earth, which is a serviceable part of the history relatively to means of prevention. In the instances I watched, this took place about the middle of July or rather earlier, and the peculiar bug-like smell, which these caterpillars have the power of emitting, was very observable when a specimen of the caterpillar was handled in being placed on the earth.

The injured Apples were not as regularly tunnelled as in the case of injury from the Codlin Moth caterpillars. There were tunnels, but also, as in the example figured at heading, a good deal of the inside of the little Apple might be eaten away, thus causing a rough blackened cavity with decaying surface. As a matter of course, when so greatly injured, the growth of the Apple is checked and it drops, and attention is drawn to where attack is present by the quantity of little fallen Apples beneath the tree.

In a communication which Mr. F. R. Murray, of Walton House, Walton, near Ipswich, also sent me (on the 8th of July) regarding the same kind of caterpillars, he likewise noticed the habit of the grubs of straying about. He remarked, "The grub seems sometimes to leave the Apple it was hatched in and then crawl to the next, touching it; and so the same grub seems to spoil many." It was also observed, as with the grubs previously mentioned, that the smell was "dreadful," and in the part of the garden where the attack took place the quantity of fruit destroyed was very great.

The observations taken in the past season agree so well with those of Prof. Westwood, so far as they refer to the same parts of the life-history of the grub, it seems to me, although we have not yet reared the Sawfly, that it is hardly open to doubt that the infestation is that scientifically described, formerly, as of the *Tenthredo testudinea*, now of the *Hoplocampa testudinea*, Klug.

The method of attack, as given from his own observations by Prof. Westwood, is, that in May he saw the female Sawflies on the wing amongst the Apple blossoms within which they settled, and on one

occasion he "distinctly saw one of the females bend down the extremity of the body in the act of depositing an egg within the blossom."

The observations of Delacour de Beauvais, as quoted by Kaltenbach,* also mention that the perfect insect flies in May about the Apple blossoms, and lays its eggs in the blossoms.

The female Sawfly is figured at heading (p. 1) from Prof. Westwood's drawing. The upper surface of the body is described by him as "shining black, the front and sides of the head and shoulders, antennæ, legs, and under side of the body being pale orange coloured, and the wings are slightly stained with brown."

The published observations which I have seen, whether German or English, concur in the grubs falling to the ground in the infested fruit in June or July, or as soon as the little Apples are so much injured within that they can no longer adhere to the tree; and that the Sawfly caterpillar then makes its way out, to go through its changes in the ground. There (quoting again from Prof. Westwood) they form their cocoons, and remain inactive until the following year, when in May the perfect Sawflies make their appearance from the buried chrysalids.

In the orchard observations of the past season, the caterpillars were noticed as straying from one Apple to another, but not either as crawling down the trees or dropping to the earth independently of the Apples.

Prevention and Remedies.—As the caterpillars go down into the earth for their changes to the chrysalis and thence to the perfect insect, it would be a sure method of greatly lessening recurrence of attack to find out, by careful examination, how deep down the cocoons lie, and then skimming the surface deep enough to clear them all off. The infested soil should be buried well down or thrown on rubbish fires, so as to make sure of destroying the contained pests, for unless this is done the work of removal will only be so much wasted labour. Gathering up the fallen infested Apples and destroying them is also very desirable.

So far as I see from Apples sent me, the caterpillars may remain for some time in the Apples after they are removed from the tree, but where there is much attack noticeable, it would be worth while to spread some large cloths under the trees successively, and shake the boughs. The Apples which fell might thus be collected and carried away, and destroyed before the caterpillars escaped.

Mere dressing of the surface even with gas-lime does not appear, from notes sent, to prevent attack.

* 'Die Pflanzenfeinde,' p. 201.

Apple-suckers, or Chermes. *Psylla mali*, Schmidberger.

PSYLLA MALI; pupa of P. PYRI.

Apple-suckers, from life, with wings expanded, and also raised as in the act of taking flight; nat. length one-twelfth of an inch. Pupa of Pear-sucker, mag., after Prof. W. Saunders.

During the summer of 1890, the little Apple Psyllas, or Chermes, were so thoroughly observed, and their life-history recorded in the observations of Mr. W. F. Gibbon, of Seaford Grange, near Pershore, and those of Mr. J. Hiam, of Astwood Bank, near Redditch, that there seems little need to say anything more on this subject. But in the past season, early in the year, Mr. Hiam found that the damage which the *Psyllas* were doing to his trusses of Apple blossom was so exceedingly great that he arranged a simple form of apparatus, by which he was able to capture the insects so successfully by hundreds, on an adhesive surface, that I give a short note of his method of operation.

The Apple Psyllas or Apple-suckers are very minute insects, of the shape figured above, only about the twelfth of an inch long. The general colour during most of their lives is Apple-green, but is varied in the mature insect in autumn with different tints, especially of red; in the words of Mr. W. F. Gibbon, "some red from head to tail, some only red about the head and shoulders, some quite green, and some milky-white." At this time the minute white or yellowish eggs, which are somewhat spindle-shaped or sometimes blunter at the extremity, are laid in furrows, or hollows, or on the down or slightly woolly growth near the extremity of the Apple twigs. From these eggs the young *Psyllas* hatch in the following spring. These are in shape much like their parents, excepting that in their early stage they are wingless.

These little Apple-suckers, where numerous, do great mischief by sucking away the juices of the young Apple buds, or stalks of the blossoms, or blossom buds.

Early in the past season (1890), Mr. Hiam sent me information of the damage which the *Psyllas* were doing in his orchard, by weakening

the middle blooms of the truss, where they could shelter themselves from insecticides, and mentioned the injured trusses might be pulled off and shaken down like chaff; in fact this season they had done him much more harm than the caterpillar attack.

To check their increase, he arranged what he mentioned as a "handy weapon," which may be shortly described as made of sundry pieces of tin fastened at the end of a long wooden lath, which served as a handle. These pieces of tin being well smeared with some greasy mixture, this adhesive surface could be raised by the long wooden lath, and waved at pleasure amongst the infested shoots, and by this simple means the *Psyllas* flying from the buds were caught in enormous numbers.

Mr. J. Hiam thus described in detail how he made his apparatus: —"I unsoldered some Tomato tins, and levelled them out flat, discarding the ends or round portions. I procured a piece of slate lath about four feet long, and smoothed the handle, and nailed four tins on the top, overlapping at the joints. I mixed some tree-dressing grease thin with a little linseed oil, and well smeared both sides of my handy implement.

"As the flies or adult *Psyllas* fly off at one's approach, they are slashed away at right and left, taking them at both strokes. By this simple plan I can easily destroy 5000 in an hour, ascertained by measurement of the surface and counting the insects on a square inch."

Mr. Hiam noted that it was advisable to re-dress the tins pretty often with grease, as otherwise, if the insects only came in contact with the bodies of those already adhering to the grease, they would escape capture. Also, he noted that many more could be caught in brilliant sunshine than on dull days.

The attack of the Apple Psyllas does not appear to be one at all generally observed, but where it occurs it has a power of doing a great amount of damage.

Note.—For life-history of the *Psylla mali* from English observations, together with means of prevention or remedy, and also references to foreign notices, see my 14th 'Report on Injurious Insects,' pp. 4—11. —E. A. O.

CABBAGE.

Cabbage-garden Pebble Moth. *Pionea forficalis*, L.*

PIONEA FORFICALIS.

Moths, nat. size; injured leaf; caterpillar, mag.† ; line showing nat. length.

The Cabbage-garden Pebble Moth is a kind which was observed as long ago as 1834 as "very common in the neighbourhood of London and in most parts of the country," and the caterpillars are known as being very mischievous, where they occur in large numbers, to plants of the Cabbage tribe, and especially to Horse Radish. The above figure, sketched from one of a number of equally injured specimens sent me from Huddersfield by Mr. S. L. Mosley, shows the power of the caterpillars of clearing away the soft portions of the leaves until scarcely anything but the harder veins and mid-ribs remain.

The moth is of the size and pattern figured above from life; the colour of the upper wings pale yellowish or ochrey, marked with four more or less distinct very narrow oblique rusty or brown streaks, also a kind of dash of the same colour at the top of the wing, and a spot somewhat behind the middle of the wing; the hinder wings whitish yellow, with a faint brownish streak running parallel to, and a little way within, the margin; all the wings bordered by a narrow brownish line on the hinder margin.

The largest specimen of the caterpillars sent me was rather over

* The English name of the moth, though somewhat cumbrous in its entirety, is appropriate, as pointing to the infestation having been specially found in gardens. The generic name of *Pionea* is used at the present day, but this moth is also given by some writers under the synonyms of *Mesographe* and *Botys*.

† The caterpillar is figured rather darker than life, in order to show the white lines between the segments.

three-quarters of an inch in length; the general shape cylindrical, gradually lessening to the tail extremity; feet 16, that is, 3 pairs of claw feet, 4 pairs of sucker feet beneath the body, and another pair (much extended) beneath the tail segment. The head greyish; under a magnifier, of a pale greenish tint with many pale grey markings; and the next segment slightly horny and greyish above. General colour greenish, brightest below; above greyer, with a central stripe, and stripe along each side darkest, the tints between these stripes yellowish, and along each side, beneath the dark stripe, a whitish longitudinal line; the upper part much freckled with minute white markings, and the segments with faint white lines between; spiracles black.

The following observations of the habits of this "Cabbage and Horse Radish Moth" were sent me, on the 28th of September, from Huddersfield, by Mr. S. L. Mosley, F.E.S.:—"One of our regular pests in garden *Cruciferæ* and Horse Radish is the 'Garden Pebble Moth,' *Pionea forficalis*. This year I have let it have its own way on a small bed of Turnips in my garden, and I thought you might like to see the results, which I send." . . . . "Garden Turnips and Horse Radish are often riddled in this way. I know of several gardens just as bad at the present moment." A few days later Mr. Mosley wrote further:—"I have watched *P. forficalis* a good deal." . . . . "I believe it is generally common, for I have found the larvæ at work wherever I have looked for them (under favourable circumstances of course), and I remember seeing both Cabbage, Turnip, and Horse Radish badly eaten at Isleworth." . . . . "Attacks are very usual here, and I could send you leaves like those I sent any season. I find the moths, in ordinary seasons, first appear about the third week in May, and the larvæ are feeding during the latter half of June and July; and a second brood of moths come out towards the middle of August, the second brood of larvæ feeding through September and into October; but in some seasons (*i. e.*, warm ones) there seems to be a succession of broods, for I have taken what appeared to be fresh imagos and larvæ at the same time."

Mr. Mosley mentioned that he had not seen the pupa in its natural condition, in fact he had not searched for it; but in confinement this was formed in a slight cocoon spun on the surface of the soil amongst dead leaves.

Dr. Taschenberg* mentions that when the caterpillars have reached their full growth they go a little below the surface and spin a somewhat cylindrical cocoon, in which they turn to a very shiny brownish orange-yellow chrysalis (of which a full description is given). In this condition they lie during July; the second brood of moths appearing in August,

* See 'Praktische Insekten Kunde,' pt. iii. p. 240.

and in October the second brood of caterpillars goes down into the soil, from which the moths appear in May.

Kaltenbach * mentions the caterpillars as feeding on the under side of the leaves, gnawing them into holes, and even consuming them to the mid-rib. Taschenberg (see previous reference) notes their feeding on the leaves of various plants of the Cabbage kind, "where they keep themselves as much as possible concealed amongst the folds of the leaves, and spin thread over the entrance to their retreats." In the case of specimens sent me together with leaves, I found enough thread (some loosely spun, some across a hollow in the leaf) to show the capability of the caterpillars for this work, and subsequently some spun, firm, white cocoons.

Prevention and Remedies.—Mr. Mosley mentioned that "the larvæ readily fall from the plant, and if knocked down as soon as mischief is detected, and a good dressing of soot or lime given, they are readily got under." Probably trampling the ground would destroy a great many; or, as this infestation appears to be especially considered one of the Cabbage garden, turning poultry in might be expected to do a great deal of good.

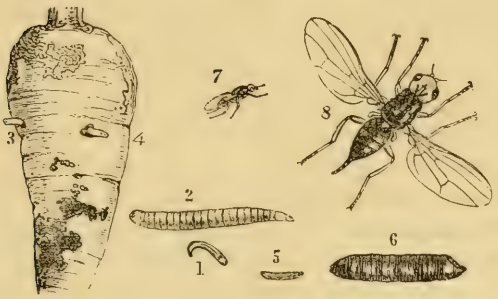
In many cases, although the caterpillars may be mostly on the under side of the leaves, these could be treated with a preventive dry dressing by throwing it sidelong amongst the plants. With Horse Radish and various kinds of Cabbage, a portion of the under side of the leaf would certainly be reached; and if some good dressing, such as Fisher Hobbs' mixture (see Index), was used, it might be expected, between what fell on the previously fallen caterpillars, and what flew about so as to adhere to the leaves, that many of the grubs would be killed, and much protection given to the leafage.

Trenching infested ground so as to put the uppermost spit down, and what was previously below on the top, would get rid of the chrysalids which lie near the surface. Even if they did develop at the unnatural depth, the moths would not be able to make their way to the surface through the superincumbent weight of earth. But in this, as in all other cases of destroying infestation by trenching it down, it should be remembered that, to ensure benefit, the pest *must be left down*. If measures of cultivation for the next succeeding crop should bring the pest to the surface again, whilst it is still alive, and (in the case of moth chrysalids) still capable of development, no good, save cultivation of the ground, will have been done.

* 'Die Pflanzenfeinde,' p. 28.

CARROT.

"Rust." Carrot Fly. *Psila rosæ*, Fab.



PSILA ROSÆ.

1, 2, and 3, maggots of Carrot Fly, nat. size and mag.; 4, infested Carrot; 5 and 6, pupæ, and 7 and 8, Carrot Fly, nat. size and magnified.

Carrot attack, commonly known as rust, is a constantly recurring cause of loss, and probably will continue to be so as long as the requisite treatment is put off until the presence of the grub at the roots is shown by the discoloured and dying leaves, instead of measures being taken previously, at the right time, to prevent the Rust Fly going down into the ground by the Carrots to lay her eggs, and thus start the infestation. A large proportion of the minute directions given by successful Carrot growers as to composts, preparation of ground, &c., turn on this point, that is, having the land in such a state that it will not draw away into cracks and so lay the roots open to attack; but besides this, the great point of all in forestalling attack, and one without attention to which all other measures may fail, is such treatment at thinning time as may deter attack, or may so close the disturbed and shaken open ground that the Carrot Flies *cannot* get down to the roots.

These facts have long been known, and the best methods of cultivation adopted for meeting the difficulty, contributed mainly by Scottish superintendent gardeners, have already been given in these Reports; but during the past year so much advance has been made, both in variety of insecticides and methods of applying them, that I give a few suggestions once again as to treatment at thinning time.

The method of life of the Carrot Fly is to go down into the ground, where she can find a chink or cranny, by the Carrots. There she lays her eggs on or by the roots, and the little yellowish or whitish maggots which hatch from these work their way into the root itself, or, if this is still very small, often destroy the lowest part. When full fed they leave the Carrots, and turn to the chrysalis state in the ground. The

chrysalis cases are cylindrical and of a rusty or ochreous colour, and from these (in summer) the little blackish green two-winged fly, with a rusty-ochre coloured head, comes out in about three or four weeks.

The few following notes are given just to show the mischief the attack is still causing, and, in the first, mention is made of the mischief beginning at the time of the last thinning.

I was favoured with this report by Archdeacon Henry de Winton, of Llandrindod, Radnorshire, on the 14th September. Mr. de Winton observed:—"The Carrot has now, for three years in succession, been completely destroyed in my garden by the pest known as 'the Carrot grub.' Its ravages are probably well known to you. This year, after carefully preparing ground for Carrots by deep digging in the previous autumn, I dressed it heavily, first with salt, then with *soot* fresh from the chimney early in the spring, and thirdly with quick-lime just before sowing.

"The seed came up, and grew admirably until about the end of July, when I had just given the plants their final thinning; since that date the grub has completely destroyed the most flourishing beds of Carrots that I have ever grown, the only difference between this and the two previous years being that this year the ravages of the grub have commenced a little *later*. In other respects the dressing of salt, soot, and lime seems to have produced no effect whatever in the way of prevention; nor have further applications of soot and lime, in the way of arresting the ravages of the grub when first evidenced by the fading of the leaf.

"When taken up, the root is found to contain several creatures resembling small white maggots, which have eaten their way into it, commencing at the lower extremity. I may add that mine is a garden first cultivated six years ago, with varying soil from stiff clay to light loam, and that for the last three years Carrots have been sown in different soils with the same result. Previously the crops of Carrots had been very good, and entirely free from any such injury. Some of my neighbours have suffered from the same pest."

Another correspondent, from the neighbourhood of Kelso, N. B., notes injury to Carrots beginning when the roots are of some size, and that its advent means complete destruction of the crop, although the soil is admirably adapted for the growth of vegetables.

Another enquirer, Mr. James Somerville, writing from Park Place, Alloa (Co. Clackmannan, N.B.), with specimens of maggots taken from Carrots accompanying, asked what could be done in the way of preventing these destroying the crop. "I have tried, year after year, to grow this vegetable, but find, when they are about half-grown, the under leaves turn quite *rusty*, and on pulling them up these maggots are seen to be boring through the root. I have tried them in fresh pasture land,

in case the ground might be foul, but always with the same result, failure."—(J. S.)

So far as I can tell, it appears that *unless care* is taken in cultivation, and in the various common-sense measures which suggest themselves to all (such as not sowing on previously infested ground), infestation is much more likely than not to appear; and that even *with every precaution*, if proper measures are not used at thinning time, the crop may be ruined by the "Rust" maggot.

We have notes of failure on good land, on fresh land where the ground could not have been previously infested, and also where care had been taken in preparation and manuring of the ground.

Bruising the young plants by careless treatment (as by treading among them) will also bring attack, as I found in my own garden in 1890. Large clumps of Scarlet-runner Beans happened to be placed at distances along one side of a long border of Carrots. The man employed to stake the Beans carelessly trampled the Carrots close by, and shortly the discoloured leafage showed the mischief had begun in front of the Bean clumps, which gradually spread on each side of the injured spots, so that the border was very obviously alternated by the cross stripes of good and bad Carrots.

The fact of attack following exactly on thinning operations was well shown in a note sent from near Dingwall, N.B., where, in 1880, it was observed that on beginning thinning, the grub began too, "and within three weeks spoiled them for use." . . . . "Late ones alongside escaped until we began to use them; but by keeping to the side the grub was on, it kept up to, but did not advance beyond, the damaged part."

How far the Rust Fly may be attracted by the smell of the bruised Carrots cannot surely be known with certainty; but it is strongly advised to remove all dead and dying plants, and broken pieces of root or leaves, after thinning. Copious watering after thinning (unless weather is such as to make it undesirable) acts well, both by closing the disturbed soil and preventing the growth of the disturbed plants being checked.

In garden cultivation this may often be done simply by the use of a garden watering-can. Where there is water supply and a hose, I have found sending a single jet of water from it *very hard*, in a straight line between or beside the rows, to answer well for slight earthing up. The force of the water tears a shallow furrow, and sends the earth flying on both sides of it on to the plants to be protected, and also gets rid of insect vermin that may be about. Any application, mixed with the water, which is beneficial to plant growth and objectionable to insects, is of course desirable.

For refreshment of the plants themselves, where there may be a larger extent of Carrot beds to be attended to, the use of the Eclair

knapsack sprayer (which was generally introduced, for orchard spraying and other purposes, into this country in the course of the past season) would be likely to be very serviceable. The spray might be given according to the position in which the delivery tube was held, either so as to fall on the leafage or to go amongst it just above ground level. Then the thorough though gentle moistening would be good for the plants, and deterrent to insect infestation, even if only of pure water; also it would to some extent moisten and "firm" the surface of the ground.

Where wished, any fluid deterrent, or plant stimulant, could of course be used. Soft-soap and sulphur compound (see Index) might be expected to be useful. Where I have tried this, much diluted as spray for Peaches and other wall-fruit trees, I have not found the slightest injury result to quite young leafage in the spring, and the slight stickiness of the soap, and smell both of the soap and sulphur, would be likely to be very deterrent to the fly if sent amongst the leafage. The strength that is safe should be tried before use on a large scale.

Sand moistened with paraffin oil, and strewed amongst the Carrots and then watered in, has been found to answer as a preventive. In this case, probably, the proportion of one quart of paraffin to one bushel of dry material,—as sand, dry earth, or ashes,—would probably not do harm, as we have found, in experiment on a large scale, that Hop shoots, growing up *through* a dressing given in this proportion to a number of Hop hills, were not the least injured.

From observations in my own garden, a dry dressing sown together with the seeds (in addition to other applications) appears to answer well. Besides the customary treatment, my gardener sowed a mixture of soot and lime with the Carrot seed, and thus when thinned the smell of the application was stirred up round the disturbed plants. The result has certainly been good, for we have not been troubled at all by Rust Fly, and have an excellent show of plants.

The details of Carrot growing, relatively to preservation from Rust Fly, have been given so fully in previous Reports and in my 'Manual,' that I do not enter on these; but the special danger to the crop being from the flies getting down cracks in the soil, and that this is most to be guarded against at thinning time, appears to need a word. In the preceding pages I have only given a few notes of methods of treatment, for these could be varied to any extent according to nature of appliances at hand, or views of the owner as to insecticides, but working on the above principles.

CELERY.

Celery-stem Fly. *Piophila apii*, Westwood.

Celery stem injured by maggot borings.

The attack of the Celery and Parsnip-leaf Fly, of which the maggot (in some years) does enormous damage by burrowing between the upper and under side of the leaf, and consequently destroying it in large patches, is well known; but the great mischief sometimes caused by the maggots of another kind of two-winged fly tunnelling in the lower part of the Celery stem, is apparently of much rarer occurrence.

On the 29th of July, Mr. Edw. Riley, of the Weir, Hessle, near Hull, when writing to me of some insect injuries which had been occurring at Epworth, added, "But the most serious attack is on twenty acres of Celery (Mr. Blaydes grows seventy-eight acres): a white grub, the size of the caterpillar on the Cauliflower (*i. e.*, about half an inch long.—E. A. O.), had *completely* eaten off the plants, about an inch within the ground; you could go down the rows and see all the tops pulled up. I never saw such destruction, scarcely a plant in a hundred left growing," . . . . "It appears to be something new. Last year they had a slight attack; it seems to be spreading in the district."

Specimens of the infested plants were forwarded me by the owner, drawing my attention to the destruction of the tissues of the root by the grub, and on examination I found the attack corresponded with that described by Prof. J. O. Westwood,* as caused by the infestation of maggots of the Celery-stem Fly, scientifically the *Piophila apii*. The above figure, which is taken mainly from that by Prof. Westwood, gives an idea of the stem when moderately attacked.

I found, in the plants sent me, that the thick base was pierced by workings in which the larvæ, or maggots, were present, and the lowest

* See vol. of 'Gardeners' Chronicle' for 1848, p. 332.

part was, in some instances, completely killed, this involving gradual death of the roots and of the whole plants. The maggot galleries often extended some way up inside the stalks of the leaves. This exactly corresponds with the description given by Prof. Westwood of "the larva burrowing into the solid stem and fleshy stalks, working its way up the latter."

On the 3rd of August, I found several maggots had left the Celery, and were moving about in the dry earth, on or in which the Celery was laid. These were about a quarter of an inch in length, or rather more when extended, yellowish white, and very shiny, and somewhat transparent; the shape cylindrical, narrowed at the head extremity, which is pointed when in movement, and obliquely rounded at the tail, which is furnished with two black spiracles; these are noticeable with an ordinary low-power hand-magnifier.

With an inch object-glass the spiracles appeared to be joined at the base by a black substance, and the tracheæ might be clearly observed passing on from the spiracles into the larva. At the anterior extremity (*i. e.*, towards the head end of the maggot) the tracheæ were furnished with external and branched spiracles, and, so far as the movements of the maggots would allow of counting these branches, they were about six in number. It was only occasionally that I could gain a sight of the expansion of the branches in which the spiracles terminated, so that for the most part these appeared simply exserted without division; but with a quarter-inch glass, and the larva at rest, I was able to make out clearly that one spiracle had six branches, besides what appeared to be the broken remains of another. The larvæ frequently curled themselves into a circle, head and tail together.

I am not aware of any description having previously been given of this larva, excepting that published by Prof. Westwood on his first observation of the attack in 1843 (see previous reference), of which I therefore append the main points, to show the similarity of the infestation.

"The larvæ are glossy white, cylindrical, grubs, having the anterior part of the body pointed, and the hind part obtusely rounded and marked by two black points, from whence proceed two delicate air-vessels, appearing like threads of gold beneath the transparent skin, and which run along the whole length of the body, as far as the segment immediately behind the head, where they form two minute exserted appendages." . . . "The mouth consists of a black horny apparatus, capable, as well as the head itself, of being withdrawn into the subsequent segment, as far as the two exserted lobes of the air-vessels above mentioned."—(J. O. W.)

Amongst the specimens sent to myself from Epworth, a second kind of dipterous maggot was present, but, as far as I could judge, only

to a small extent, and probably only preying on decayed matter. This was distinguishable by the caudal extremity *not* being rounded, but rather slightly dilated, and furnished with numerous tubercles. To make sure that this was not merely an early stage of the larva of the *P. apii*, I examined a series of these in different stages of growth, and found these, from the smallest (which might be about an eighth of the size of the largest I had), all corresponding in structure.

Circumstances prevented me, at the time, following up details of life-history; but these will be found given at length by Prof. Westwood, with figure of the fly, maggot, and other details, at page of 'Gardeners' Chronicle' for 1848, previously named. From these I may quote, shortly, that Prof. Westwood found the maggots present in the Celery in the month of February; that these maggots turned, in the diseased Celery stems (or in the earth in which they were placed), to chrysalids or pupæ, within an elongate oval case formed by the hardened maggot skin; and from these chrysalids the two-winged fly came out about the middle of May. This fly he found to be very like the common Cheese Fly. It was about three-eighths of an inch in spread of the wings; thorax and abdomen black; head mostly chestnut colour; legs very pale straw colour, feet more dusky; wings colourless, with veins very pale buff. The body is described as sprinkled with fine golden grey hairs.

Prevention and Remedies.—The observations of the past season have added to those previously quoted, the certainty that there is a summer generation, as I found specimens, only somewhere about the sixteenth of an inch long, amongst those sent me at the beginning of August. The second brood is presumably very soon developed from chrysalids of these maggots, and if any measures could be taken to destroy these it would save much mischief.

For one thing, whether with summer or winter infested plants, a rule, stringently carried out, that the plants were in no case to be thrown to the manure heap, but burnt, or buried in wet manure, or so treated that any chrysalids which might be in the stems should be destroyed, would save some infestation.

Where there has been a complete destruction of the plants by infestation, probably a heavy dressing of gas-lime along the trenches, and leaving the ground free until the air had neutralised the noxious qualities, would destroy such chrysalids as might be in the earth. Or, again, turning the earth well down into the trenches, and planting on these some winter crop, which might be dibbled in, would at least secure a return from the ground, though not in Celery, and would leave the insect vermin buried safely down, out of the way of infesting other plots.

If any practicable measures of checking this attack are known by Celery growers, it would be a great advantage to all if they would make them known, for though palliatives may possibly be brought to bear, it is much more likely than not that, where such a large area as seventy-eight acres of crop is grown, there is no means of getting the infestation under,—of a maggot feeding *within* the plants, and a fly, only about the size of a Cheese Fly, *without*,—except a change of crop. Thus, as with Mustard Beetle, and other attacks of insects to crops grown largely and long in a district, by removing the chief food of the pest it may not be totally cleared, but its overwhelming presence is locally checked.

CORN AND GRASS.

Cockchafer. May Bug. *Melolontha vulgaris*, Fab.

MELOLONTHA VULGARIS.
Common Cockchafer, maggot, and pupa.

The following notes regarding the grub of the common Cockchafer Beetle, are inserted to show how near the surface of the land they may be found in winter. Also as giving practical example that, though grubs or other insects can bear severe cold, so long as they are in the shelters which they have made or chosen for themselves, yet if turned out of these on to the surface, where they are *exposed* to influence of unfavourable weather, and from this, and possible winter torpidity, are not able to shift for themselves, multitudes may thus be destroyed.

On the 2nd of February, Mr. J. England Wilson, writing from Springhill, Skene, Aberdeen, N.B., forwarded me a Cockchafer grub, with enquiries as to its nature, and mention that it was found in that neighbourhood, but only in good land when it was being ploughed.

One great difficulty in dealing with this attack is the depth at which these long-lived grubs shelter themselves beneath the surface in winter, which may very possibly be lower than where they can be turned out by common measures of cultivation. The regular method of life (as is well known) is for the female Cockchafer to go down, in early summer, some six or eight inches deep in the ground to lay her eggs. The grubs which hatch from these come up to within a few inches of the surface of the ground to feed, and attack the roots of Grass, various kinds of crops, and young trees. They feed, in warm weather, for three years, going down in winter to a greater or less depth according to circumstances, and at the end of the third summer go down to a depth stated to be two feet or more. Here they change to the perfect state, the Cockchafers making their appearance early in the following summer.

The grubs (from being buried down out of sight) are not as well known as they should be, for a sight of one accidentally turned up would often give the clue to the cause of much mischief. They are easily distinguishable by their large size when full grown, and their peculiar shape, figured at p. 18, the whitish fleshy body being swollen at the tail extremity into a kind of sack, usually of a bluish colour. They are also distinguishable by having three pairs of long brownish legs; the chestnut-coloured head is furnished with strong jaws. In common with some others of the Chafer grubs, they habitually lie, as figured, on one side.

In reply to some of my enquiries as to depth of the grubs beneath the surface, Mr. Wilson mentioned:—"On our Grass-land, which is being broken up, there is a lot of foggage, *i. e.*, old Grass which acts as a good protection from the frost. They have not been further down, and only now coming to the surface, because I find them always at the bottom of their burrow. As the land is ploughed at a uniform depth of five-and-a-half inches, we consequently see only those that are lying from five to six inches down. Those we do see would amount to a few hundreds per acre." In reference to some observations as to methods of clearing the grubs, Mr. Wilson remarked:—"We would not need to have pigs picking them up here, as the plough is almost always followed by crows, starlings, &c., which do not leave any grubs about. They (the grubs) have not sufficient vitality to re-bury themselves, as I left some on the surface over-night. I do not think they are very common about here. They occur chiefly in good land. As our land is a sandy loam on a gravel sub-soil, it is comparatively warm soil, and would, I

imagine, thus be congenial to most forms of insect life. I could not assign any other reason for their occurrence, except that we are almost surrounded by woods of Scotch Fir."

This might very possibly be from the grubs feeding at the Fir roots. In 1882, I had notes of much harm being done to young seedling Firs by Cockchafer grubs removing the bark in large patches from the main root, and in the previous year "thousands of the Fir plants" at the locality had been destroyed. Another note was also sent me of very bad injury, at Eardiston, in Worcestershire, to a young Pine plantation, mostly Scotch Fir, from grubs of the common Cockchafer devouring the roots close to the collar.

In its perfect state, that is, as the Cockchafer Beetle, it does not appear to frequent the leafage of Coniferæ; it is noted in the 'Forst Zoologie' (Insecten), of Dr. Bernard Altum, that it will attack the Larches "not unwillingly," but spares the other kinds, with the exception of the male blossoms of the Pine, or Scotch Fir ("Kiefer"). For the most part the Cockchafers attack the leafage of the common forest trees, as Oak, Beech, Elm, &c., but, failing other food, they have been known to supply their needs from "vegetables." This would account for the grub having been reported to Mr. Wilson as present in Orkney, which, he observes, is "innocent of trees."

On asking Mr. England Wilson for the lowest temperatures, about the time when the Cockchafer grubs were turned out alive on the surface, he supplied me with the following readings. These were taken at the Dunecht Observatory Station (about four miles distance), at 9 a.m., from a minimum thermometer in a Louvre box about four feet above the ground, and were the lowest readings of the season :—

1890, Nov. 28th, 18·9°; Nov. 29th, 16·9°.
1891, Jan. 8th, 13·8°; Mar. 9th, 17·0°.

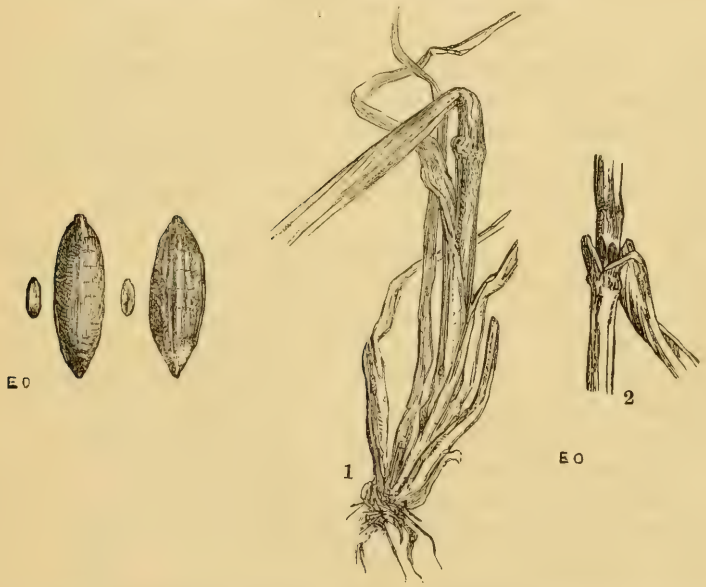
This of course does not give the precise temperature, either on the surface of the ground or at five to six inches below it, where the caterpillar was turned up from, but shows that they could stand a cold of approximately 18° of frost without being killed by it, so long as they were left in their own shelters; but when turned up to the surface, a fortnight or so after, then they had not vitality enough to make new shelters again in the ground.

Later on in the season, I had Cockchafer grubs and a surface caterpillar sent me from near Dorchester, by Mr. Arthur Edmondson, as examples of an attack which was then, the 23rd of September, doing mischief in a piece of white Turnips.

Such means of prevention and remedy as can be brought to bear have been previously entered on, but almost the only practicable plan for clearing the grubs appears to be ploughing, so as to turn them out

on the surface. Thus in winter they may be killed (as above mentioned) in large numbers, or otherwise may be collected by children; or they may be killed by turning on pigs. But various kinds of wild birds are especially useful. Amongst these are rooks, the black-headed gull, and the common gull, and these should in no case be interfered with in their work. Of the "common gull" it is noted, in Yarrell's 'Brit. Birds,' that "this bird frequently goes some miles inland to follow a plough in search of insects and grubs." And of the black- or brown-headed gulls it is noted, in a quotation by the same writer relatively to their habits at their breeding-place at Scoulton Mere, in Norfolk, that "they spread themselves over the neighbouring country to the distance of several miles in search of food, following the plough as regularly as rooks, and, from the great quantity of worms and grubs which they devour, they render essential service to the farmer."

Hessian Fly. *Cecidomyia destructor*, Say.



1, Barley stem elbowed down by Hessian Fly attack; 2, showing position of "flax-seeds." Also "flax-seeds" or puparia, nat. size and magnified, showing the early and smooth, and the later or striated, condition.

During the past season very few observations were sent of presence of Hessian Fly, and none of it doing serious damage; and save to show how little we are suffering, in our insular climate, from this attack, which has the power of ranking amongst the worst Corn scourges in

less favoured countries, it would be hardly worth while to mention it again.

The fullest return sent in was the following, with which I was favoured by Mr. Edw. Blundell, Prof. of Agriculture at the Royal Agricultural College, Cirencester. Mr. Blundell mentioned that during the vacation he had opportunities of visiting the harvest fields in many different counties, and had found the puparia of the Hessian Fly on the College Farm and in other parts of Gloucestershire. Also in Bedfordshire, where Prof. Blundell is still carrying on a farm; at Rothamsted; and near Welwyn, in Herts; and near Sevenoaks, in Kent, &c. But he further observed, "I am glad, however, to say it was only by careful searching that I was able to find them in some places, and they certainly have not been so prevalent as in some previous years."

Mr. Eardley Mason, writing from Alford, Lincolnshire, on the 21st of July, mentioned that Hessian Fly attack was much less abundant than in the previous year (1890), and that, though it was in every field, diligent search was required to find it.

Mr. D. D. Gibb, writing from Ossemsley Manor Farm, Lymington, Hants, on the 18th of July, mentioned:—"About a fortnight ago, I found puparia of Hessian Fly in Wheat plants, and to-day again came across one; evidently this attack is slight. As the puparia are mostly located at knots close to the ground, they are not easily distinguished; this would, I suppose, indicate attack at an early stage of growth in the plant.

Some other passing allusions to presence may have occurred during the season, though no report of damage, to a serious extent, having taken place in this country has reached me; but I give the following account (by favour of Mr. J. J. Willis, Superintendent of Sir J. Lawes' Experimental Grounds at Rothamsted) as an example of such virulence of attack, occurring no further from us than about twenty miles from the north coast of France, as to show other characteristics of presence beyond what are usually observable in this country.

With us, as we well know, the common form of attack is for the Hessian Fly to lay one or more eggs, a little above a knot in the Corn stem. The little maggots feed by drawing away the juices, without stirring from one spot, and consequently, where attack is severe, the weakened stem gives way, and elbows down just above the injured part, as figured at p. 21, and when examined the pest is usually to be found present, then advanced to what is called the "flax-seed" state, that is, a small, flat, brown chrysalis case, in shape and size much resembling a flax-seed (for figure of this, also see p. 21).

On the 10th of Sept., I received a large packet of French specimens, sent me on the part of Mons. Gabriel Eripier, as samples of a

peculiar and injurious Wheat attack, of which the cause was not known, which was then occurring in the neighbourhood of Airaines, in the Department of Somme, in the north of France. On examination I found the specimens to be of stubble of a large-stemmed Wheat, having, in most instances, an unusual number of very thin shoots, from a few inches to a good many inches long, surrounding the base of the plants. In one instance, where the whole plant was sent as a specimen of the complete attack, I found, besides these spindly abortive shoots, the ear-bearing stem,—still of a very full green, but with the ear quite abortive,—long, very thin, and unable to free itself from the sheath, and the joint below much shortened, and round the base of this deep green stem were numbers of the abortive withered spindly shoots.

This green ear was described by Mons. Eripier as a characteristic of the attack. He observed, "There are some fields where about a third of the ears are quite green still, while two-thirds are ripe. The green ones are of a somewhat longer shape, so that at first sight they look as if they came from seeds of a different variety." Mons. Eripier suggested that this difference was to be ascribed to the retarded growth of the infested plants,—that is, to the injury caused by the larva,—the same being constantly found at the foot of the plants bearing the green ears.

The appearance of the plants was very peculiar, and at the first glance at the sheathed ear, and at the numerous shoots, suggested rather some form of "Gout" or *Chlorops* Fly attack above, and "Segging" or Tulip-root below, than Hessian Fly attack. The condition, however, appeared not at all unlike that described by Dr. Lindeman as occurring where the Corn is in bad condition, or where there are at one time such an extraordinary number of the Hessian Fly larvæ present that the infested plants die before they have formed their ears or reached their full growth. Dr. Lindeman notes, "I have observed such Rye and Wheat in Southern Russia, where nine stems from one root had perished before forming ears, and only one had reached to carrying an ear, and that of backward growth." *

On handling the plants sent me, I found that *puparia* (flax-seeds) of the Hessian Fly dropped from them; and I carefully examined the remains of the upright stems of stubble for specimens *in situ*. Here, however, I only found a single specimen, and that, curiously enough, was placed on the stem, *below*, not above, a knot. I then proceeded to examine the thin, short, or abortive shoots which were so numerous round the base of the stronger stems of some of the Wheat plants, and

* Die Hessenfliege (*Cecidomyia destructor*, Say), in Russland, von Dr. K. Lindeman, Moscow, 1887.

here I immediately found puparia at the lowest part of the shoots, which were plainly stunted by the presence of the infestation.

The flax-seeds were usually covered by the sheathing leaf, but were easily to be found on careful examination, as, from the stunted and small size of the stems (irrespective of their length), the slight lump caused by the presence of the "flax-seed" was noticeable as bulging out beneath the thin leaf in a way which would not have been observed on a moderately well-developed stem. These stems were so thin that there was very little room for numbers on one stalk, but I found quantities of stalks infested by one or two, and in one case by three, flax-seeds. The infestation was mainly (if not entirely) at the bottom, or near the bottom, of the stems.

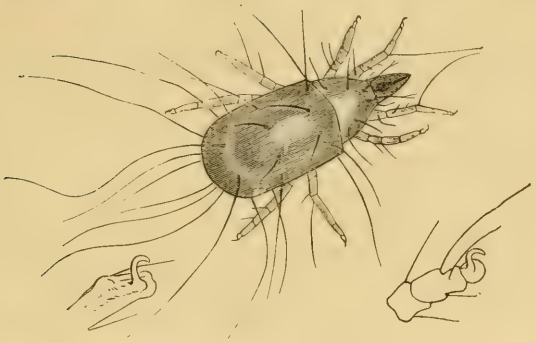
The "flax-seeds" corresponded with our English specimens in size, shape, and colour; they were just the same tint of brown, and the little pinch-in near one end (as if a nail had been pressed on the chrysalis case) was clearly noticeable. On removing the contents of one "flax-seed" case which was not much advanced, I found that the maggot within was clearly that of a *Cecidomyia*, by reason of it possessing an "anchor-process," or breast-bone as it is sometimes called, which is one characteristic of Cecidomyideous larvæ, and, on further examination, the free extremity of this minute process, which lies beneath the body of the larva at the head end, quite *precisely* accorded, in its bifid shape, with that of the larva of the Hessian Fly, the *Cecidomyia destructor*.

I have entered on the description of this unusual form of effects of Hessian Fly on the attacked plants at some length, as (though extra British) a locality about half-way between Paris and Calais is not very far from our own shores, and without careful examination the plants affected, as above mentioned, might so easily be passed by as suffering from some other attack, that it can do no harm to notice this form of neighbouring Continental development.

We are well acquainted here with the very best methods of prevention and remedy, but in the above case, as it was of great importance to stamp out a previously unobserved attack, and also difference in climate might allow different measures to be brought to bear, I suggested that, if possible, it would be desirable to fire the stubbles of the attacked fields, and so *stamp out* the infestation without delay.*

* By permission of Mr. J. J. Willis, through whose hands the infested plants were forwarded to me, I gave a description of this attack in the 'Agricultural Gazette' for Sept. 21st, a portion of which description is repeated above.

Mites (in Hay). *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.

T. longior (from fig. by Fumoze and Robin): claw and sucker of *Tyroglyphus*, right-hand side (from Murray's 'Aptera'); claw and sucker on left-hand side, figured by ED. from life: all magnified. Nat. length rather more than half the 25th of an inch.

The presence of Mites in hay continues to be reported, and (though probably only from attention being drawn to the subject) more so than in previous years, and, as regards their presence in stacks, up to the 6th of November we seemed to be as far as ever from knowing why they are there, or how to get rid of them. Then, however, some very noteworthy information was forwarded by Mr. Thos. Fraser, of Ardfin, Isle of Jura, N.B., showing that the Mites are first observable in the fields beneath the haycocks or tramps. This is a very important clue to the original locality of the infestation, and I give Mr. Fraser's notes *in extenso* at pp. 29, 30. Some other information, also, we have gained; the attack is nothing new, having been noticed as much as some five-and-twenty years ago; it is wide-spread, as observations of its presence are given in Scotland, at localities respectively in Berwickshire, Aberdeenshire, and the Island of Jura; in England, in Yorkshire, and Cheshire; and it is rather curious, though very likely only a coincidence, that most of the localities are on, or near, the sea coast. Also it is observable that it is not reported from the more southerly parts of England, and some of the observers notice the infestation as being found in hay which has been well saved, but not heated. In some cases, where the kind of hay infested is noticed, this is named as Rye-grass, not meadow hay; also we have notes of the Mites disappearing from round the stacks with the arrival of cold, wet weather in autumn, and also, where infested hay was stored in lofts, of the creatures dropping in the succeeding summer from the previous year's hay.

These respectively indoor and out-of-door observations may give us some clue to prevention, otherwise we have made no advance in

this direction. We have, however, notes that, excepting annoyance to horses from the Mites in infested fodder causing coughing by reason of the tickling in their throats, otherwise no harm at all has been observed as caused by their presence; and it will be noticed, in the communications by Mr. Colin Campbell, that relatively to this point he especially mentions that Mite-infested hay was fed to a large fold of in-calf cows, young cattle, horses, and dairy stock, without doing them the slightest harm.

This cannot be considered as an important attack; still it to some degree lessens the value of the hay, and in every way we should be much better without it; therefore I give the observations of the past season, from which the above summary has been taken, hoping that they may lead to further notes of how to prevent infestation, or clear Mite presence from the fodder.

These little "Mites," or *Acari*, are quite indistinguishable, without strong magnifying powers, from the common Cheese Mites, which may constantly be seen lying in little heaps, like greyish or yellowish powder, where they have fallen, on a dish or on dairy shelves, from infested cheese; only, in the case of the Hay Mites, they may be found in great masses round the stacks, or dropping from the infested hayloft.

The figure of this Mite (magnified) at p. 25 gives its general appearance, with its crab claw-like jaws, and also with the long hairs which are one means of distinguishing it from the nearly allied "Common Cheese Mite" (*Tyroglyphus siro*), and also the single claw and sucker at the end of the foot, which is a characteristic of this sub-genus of *Acarina*, or "Mites," namely, the *Tyroglyphi*. It is almost impossible, however, for any one who has not made a special study of these minute creatures to identify them from mere description; therefore when first brought forward, in 1886, we obtained a trustworthy identification by Mr. Albert Michael, and since then such of the consignments of Mites as I have examined microscopically have agreed with those first noticed, and the most observable points, which can be seen by fairly high microscopic powers, are given in my preceding (14th) Report.

Early in April, Mr. J. England Wilson, writing from Springhill, Skene, Aberdeenshire, forwarded me, accompanying, "a sample of Mites with seed taken from the floor of a hayloft." He noted:—"The hay is Rye-grass and Clover, well seasoned but not heated in stack. It possesses no perceptible odour. Horses eat it, but cough very much, owing no doubt to the Mites irritating the windpipe."

About the same date Mr. David Byrd, writing from Bunbury Heath, Tarporley, Cheshire, mentioned:—"The Mites in hay we have long observed." . . . . "We also find them in our granary. When the

Corn is removed and the floor swept, we very shortly find a gathering like a handful of dust on different parts of the floor. Mites, if neglected, will very soon lessen the value of cheese by losing its brightness, but in hay the mischief may not be so easily seen; they may to some extent destroy the aroma which good hay should have."

The following note of enquiry, forwarded to me by the Editor of the 'Farming World,' also speaks of the Mites being found in a loft as well as in the stacked hay, and in this case in Clover hay. The note was as follows:—"A few weeks ago I bought from a neighbouring farmer ten tons of what I thought to be good Clover hay. It was brought home, and part was made into a stack, the other part being put into the stable loft. The hay is now living with Mites, and I wish to know if, when eaten in such a state by horses and cattle, it will prove injurious to them?"

The following note, which I am permitted by the observer to use, though not originally sent to myself, was written on Sept. 15th, and notices the great quantity of what proved, on examination, to be the same kind of Mites found on the ground or straying about by a haystack:—"I was at a place in Berwickshire last week, and at lunch we leaned our guns against a haystack. On lifting them we found them powdered with white Mites, and on looking at the foot of the stack we found the ground covered with a thick powder of the Mites, which had evidently dropped from the stack. No one of the party had ever seen such a thing before, nor had any of the farm servants. I send you a tin with some of the Mites, and will be obliged if you will tell me if you have seen anything of the kind before, and if so what they are, what has caused them, and if they are likely to be injurious."

In this instance the Mites were presumably in the substance of the stack, for in a subsequent letter my correspondent remarked, "The farm bailiff mentioned that when cutting the hay the men had complained of it being full of lice." As this word is by no means limited popularly to its technical meaning, in all probability it was used in this case in reference to the Mites.

Notes came from other places, as for instance, an application, with specimens accompanying, from Upleatham, in Yorkshire, mentioning the Mites as being picked up close by a haystack, and desiring information as to what they were. Also, on the 25th of Sept., Mr. John Speir, of Newton, near Glasgow, writing to the 'Farming World,' in reply to some of my enquiries, gave the following observations:—"No one need annoy himself about having Mites in his hay, as it is only well-saved hay which produces Mites. I have seen them an inch or more deep on the ground round a hayrick, but as soon as the cold or wet weather sets in they all disappear. This is the most common-sense way of clearing them off, which Miss Ormerod asks about, that

I know of, and I certainly never saw Mites in hay in October or later, and in most years they disappear very much earlier."

The following notes, with which I was favoured by Mr. Colin Campbell, of Jura, N.B., also point to method of saving the hay having an effect on the amount of Mite presence, and also (together with some other observations) to the infestation being most noticed in Rye-grass hay; and further show that this infestation is one of long standing. Mr. Colin Campbell, writing on the 30th of Sept., remarked :—"With regard to Cheese Mites in hay," . . . . "I see them every year in the Rye-grass hay in Jura, and they do stock *no harm* whatever. I see Mr. Speir, in 'Farming World,' states they disappear when the cold weather sets in; I can't say as to this, but if so they certainly reappear in summer again, as I noticed them falling on to the heads of the horses from the lofts above, and that was last year's hay. I have never noticed the Mites in meadow hay, but of course they might be present."

Mr. Campbell also wrote me, a few days later, relatively (amongst other points) to this attack being most prevalent in the more northerly parts of the island :—"There is no doubt that it is more of a northern infestation, and in Scotland it is not the practice to allow hay to heat, which may account for them being present. It is generally the case that good well-saved hay is most infested. I enclose a cutting of the letter I addressed to 'Agricultural Gazette' after reading your Report of 1890." This was as follows :—

"Mites in hay.—Some five-and-twenty years ago, when a lad going about the home farm at Jura, N.B., I often used to wonder at the quantity of light-coloured, dusty-looking material, that used to drop on the window sills of a large hay-barn (stone and slated), which was fitted with windows and louvre boards, and often in passing I used to disturb it with my stick or hand, and was always puzzled on finding that when next I passed the mass appeared level again and my marks obliterated. One day I made a small heap of it, and then noticed for the first time that it moved about and was a mass of insect life, corresponding with the Mite mentioned in Miss Ormerod's last Report on Injurious Insects, &c. The hay stored in this barn was always first and second year's Rye-grass hay, which never heated, as it was allowed to stand a considerable time in tramp ricks in the field to season, as it had to go into this built barn. The Mites appeared to me to give off a sweet smell, rather like honey.

"I have never noticed these Mites in meadow hay, of which a quantity was stored in other lofts, but they may have been present without attracting my attention.

"For the information of your readers I may state that this hay was fed to a large fold of in-calf Highland cows, young cattle, horses, and

dairy stock, without doing them the slightest harm or producing any ill-effects."—From ' Agricultural Gazette ' for March 23rd, 1891.

The following notes, with which I was favoured on the 6th of Nov., by Mr. Thos. Fraser, from Ardfin, Isle of Jura, N.B., are well worth careful perusal. It will be seen that the Mites are found under the "tramps" or "cocks" in the field. This shows the locality of the Mites as being in the Grass field; and Mr. Fraser's belief that the Mites are at this time smaller than later in the season, points to them being then not long hatched; for later on, when I have had them from haystacks or lofts, there have been large and small (old and young) together. Looking at the fact of the very nearly allied Cheese Mite, the *Tyroglyphus siro*, being also a feeder on flour, there seems no reason against this species of *Tyroglyphus*, also a Cheese Mite, feeding, as Mr. Fraser suggests, on the seeds or on the anther dust of the Grass blossoms. Also, as I suggested (page 45 of my 14th Report), these Mites do not seem entirely at home *in* the artificial situations of haystacks or lofts, as they are commonly reported as in great quantities outside, "even to being dropping by shovelfuls." The attack having now been traced so far on towards its source, it may be hoped that in the coming year a little investigation in the field (magnifier in hand) may complete the life-history. Mr. Fraser wrote me as follows :—

"It is the general practice in hay-making in the West of Scotland (West Highlands), as soon as possible after cutting or mowing (which ranges from the end of June to the end of August), to have the hay collected in large tramps or cocks on the field, where it is allowed to remain for some time. The first appearance of the Mites (to an ordinary observer) are when removing the said cocks or tramps from the field. While forking the hay from the bottom or lower part of the cock on to a cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and, from the backward position of the worker's head at the time, they stick or adhere to the face in a very short time, causing itchiness or irritation on the skin. At this stage, I think, they are less in size than they are when found, a fortnight or so later on, emerging from the recently made stacks. A certain amount of moisture or damp in the hay (more so in a wet or moist climate, such as along the Atlantic seaboard), as we have in the *west*, causes a perspiration or sweating, or perhaps heating in the hay, and this may to a certain extent be the reason why the Mites, being uncomfortable, make their exit to the outside of the heap or stack as the case may be. One remarkable thing is, that they can move along or extend themselves on an *even* surface, or wooden floor, for a considerable distance, somewhat in the way the honey-bees do against the hive before swarming, only that they differ inasmuch that they do not appear to

have the power of suspending themselves as the bees do. But when they extend (*i. e.*, the Mites), they do so in a *continuous* mass, sometimes several feet outwards.

"They have been in Rye-grass and in meadow Grass this season, but more abundant in the former. During the month of September and early part of October they showed, or appeared to be, at their greatest strength and activity; after the middle of October they gradually showed less vitality and power to move or extend, until now (the beginning of November) all life is apparently gone, and the mass of the once living organism has shrunk into less than one-half its original size.

"I cannot say, but the probability is, that the Mites are nourished or sustained on the heads or seeds of the hay. And the fact that they are to be found more abundant in Rye-grass seems to strengthen this argument or idea, as the powdery anthers are more prolific or profuse on this Grass than on meadow Grasses.

"In appearance and colour they closely resemble the Cheese Mite. They are to be met with in the North of Scotland, but not nearly to the same extent as in the west, where the climate is much warmer and moister, the north being colder but much drier."

Prevention and Remedies.—In lofts where hay is commonly stored, it would be desirable, after a supply has been finished, and Mites are found to be so numerous that (as noted by Mr. Byrd) they can be swept into little heaps, to have a thorough cleaning. A complete sweeping together first, from all accessible places, whether floor, or walls, or rafters, or any other parts, and especially the darkest and most sheltered spots, and burning the collected masses, would be well to begin with. This, if followed up by washing down with scalding water, application of soft-soap wash (all the better for just a little paraffin oil in it), and such applications as whitewashing walls, tarring rafters, &c., could not fail to tend very much against reappearance of the attack indoors.

Out-of-doors, we need to know how and when they get into the stacks. We have no observations of the infestation being in the Grass when *being* saved; that is, nothing to connect the infestation with being brought from the fields, in the seed-heads of the Grass or otherwise. We have it noticed as brought with hay, or being present in, or rather as dropping from, hay; and it occurs whether, in these instances, the Mites may not have taken up their quarters in the rubbish which may often be left, year after year, on the site where one stack after another is placed, and so infest the new hay.

Where stacks are placed on any foundation which can harbour Mite-vermin, especially of rough wood and logs which allow much old

hay to slip down amongst them, it would be well for the owner or a superintendent to examine into the state of this footing, before a new stack is built on the site of an infested one, and attending to the state of the case as circumstances directed.

In the south-west of Gloucestershire, where for a long series of years I constantly saw the haystacks on the family property, I cannot remember ever seeing or hearing of this attack either on the home farm or those of the tenants, and there the hay was customarily much more liable to be over- than under-heated, this up to danger of firing, as shown by the stacks having, as no uncommon thing, to be partially unmade to cool, or by the black colour (showing a scorch had occurred) when cut for use.

Common-sense measures, such as throwing quick-lime or gas-lime, or running a band of tar on the ground, or some waste material round the stacks, from which the Mites drop in great quantities, suggest themselves. The Mites would thus be prevented straying about in legions to continue infestation; but in the light of the information received when these pages were passing through press, it may turn out that (if thought worth while) measures may be taken in the field towards preventing transit of Mites to the stack.

Wheat-bulb Fly. *Hylemyia coarctata*, Fallen.

Wheat-bulb Fly (*Hylemyia coarctata*), magnified, and lines showing nat. size; maggots and chrysalids, nat. size and mag.; mouth apparatus, and extremity of tail, with tubercles, mag.; infested plant.

The only one of our commonly observable Wheat- and Barley-stem attacks which has very noticeably held its ground during the past season (that is, so far as is shown by amount of observations forwarded) is that of Wheat-bulb maggot. Corn Sawfly was not noticed as

troublesome, and *Chlorops* or Gout Fly was little reported, although, from notes placed in my hands by Mr. Edw. Blundell, Professor of Agriculture at the Royal Agricultural College, Cirencester, the Gout Fly appears to have done considerable damage to Barley in some localities.

The Wheat-bulb maggot, however, was very noticeably present, as enquiries regarding the attack began towards the end of April, were forward on seventeen days of May, and continued to some slight extent into June. The localities written from regarding the attack were, with the exception of Gloucestershire, on the easterly side of England, namely, from Essex, Bedfordshire, Cambridgeshire, Lincolnshire, and Durham.

The following observations will be found to confirm those of preceding years, as to the attack of Wheat-bulb maggot being customarily found (where it occurs at all) on land which has been fallowed, or otherwise much exposed to the sun, in the preceding summer. Details of various points are also given by various observers, which, by collating them together, appear to point strongly to this attack being set on foot by maggots from eggs deposited before the time of autumn Wheat-sowing on the exposed land. These points are brought forward for consideration together, in the "summary" following the observers' notes.

On the 28th of April specimens of infested Wheat were sent me from Cottenham, Cambs., with the remark, by Mr. Robt. Norman, the sender, that he had known hundreds of acres ruined by the maggot. On the same day also specimens were sent by Mr. J. Hunt from Coton, as being of an attack previously unknown in the district, and that the maggots "entirely destroy the plant, and leave the field bare."

On the 5th of May, Miss M. F. Curtis Hayward, writing from Quedgeley, near Gloucester, observed of this same attack:—"We have a field of Wheat that has failed, and died off after coming up at first strong and well. The stems, a little way above the root, appear to have decayed, as if they had been attacked by some pest." The grub taken from one of these stems, and sent as a sample, proved to be of the *H. coarctata*, and a few days later Miss Curtis Hayward further noted:—"Since writing, we have heard of several instances, in the neighbourhood, of Wheat attacked in the same way as our own, and no doubt by the Wheat-bulb maggot. One farmer has lost ten acres out of forty."

The following note, sent me on the 18th of May, by Mr. S. G. Jones, from Hatherleigh Court, near Gloucester, is of much interest; first, in showing that we are in no way benefited by the severe cold of last winter in getting rid of these maggots; and next, in confirming previous observation as to the great influence exercised by previous

state of the ground, or even slight difference of locality, or method of treatment at the time of putting in the seed, on presence of this kind of maggot attack. Mr. S. G. Jones wrote as follows:—

"I send you sample of Wheat plants, taken out of the ground to-day, from ten acres sown on the 10th October, after bare fallow. Before the hard frost, the crop was up and looked well, and early in February, just before the second heavy fall of snow, a good dressing of soot was applied. The same seed was planted on the same day on adjoining land, but following Beans, and is now a very strong crop. The extraordinary thing about this ten acres is, that round the 'headlands,' where the seed was drilled in the opposite direction, there is a *good crop now*. The good crop forms a sort of frame, and where the picture should be the crop has entirely gone off, as per sample sent, except just in the furrows at the lower end of the piece."

The following notes by Mr. Robt. Norman, previously quoted, also turn (after the first observations) on the effect of state of ground, or of method of cultivation, on amount of attack. Mr. Norman mentioned, with regard to the maggot, that this "I have unfortunately been acquainted with for many years, to my cost, and am able to tell very early in the season when the crop is attacked." Further, Mr. Norman observed, regarding the maggots:—"After a fallow, on land with which I am acquainted, the Wheat almost invariably 'goes off' by them; also where the land is stirred, by ploughing, scarifying, or harrowing, during the months of September and October, it appears to propagate them. I could give instances where land lying contiguous has not been stirred, and the plant has escaped the attack."

The following observations, from Mr. Wm. C. Gardiner, of Little Yeldham Hall, near Halstead, Essex, note the extent of mischief caused by the maggot by April 30th, the date of the first note; the second adds one more to the many previous observations of appearance of this infestation after fallow. Mr. Gardiner wrote:—

"I take the liberty of sending you specimens of maggots or grubs which are devouring my Wheat plant, and are quite different from any kind of insect that I have known to prey on the young Wheat. Before, I had a full plant all over the field a month ago; and where the maggot is at work, it has wasted quite 50 per cent, and is still going."

On May 9th Mr. Gardiner wrote:—"I may say that the preparation for Wheat was, Red Clover a full plant at first, but it gradually died off; so folded it with sheep, and broke the land about July. Being clean I did not touch it any more till October, when I planted the seed. It being a very warm September and autumn, I can quite understand the land being in a favourable condition for the fly to lay its eggs under the furrows."

The following report,* sent on May 8th, by Mr. William Sewell, of Tillingham, Southminster, Essex, also mentions great damage, and prevalence of the attack after fallow:—"The last three years we have had a maggot eating our Wheat in these parts, and this year it is doing more harm than ever, many of the Wheats being so bad that they have to be ploughed up in some cases, and patched with Oats in many others. The maggot, of which I enclose specimens, lives in the heart of the stem of the Wheat, eating it completely out, and then going on to another piece, making the Wheat, where there was originally a very good plant and looking very well, almost completely disappear. It seems to appear in the Wheat about the beginning of April or end of March, and to attack Wheat, particularly, grown on whole fallows. Where winter Tares are fed off, and then the fallow is made, they are bad, but not quite so much as on a whole fallow; and where spring Tares are fed off later still, they are less harmful. Also, on Clover layers (one crop cut, and then broken up) they are the same as on Tares fed, and Pea-etches sown with Wheat seem a favourite place for them, but Bean-etch Wheat seems quite free."

About the same date, that is, on or just before May 8th, Mr. G. W. Sanders wrote me from Church End, Haynes, Bedford, mentioning:—"Several of the Wheat crops in this neighbourhood have been dying off during the past month. On examination we find it is caused by a small worm in the stem near the root." Specimens were sent, as well as infested plants, in which some of the maggots were fairly full-grown; and in reply to my letter on the subject, Mr. Sanders noted that "all the fields where the Wheat has gone off are after fallow, both on my own and neighbours."

Mr. J. Alex. Henman, on the 13th of May, sent me specimens of the maggot from Bromham Grange, Bedford, as samples of an attack which was destroying his Wheat plants; and a few days later, like other observers, noticed it as worst after fallow, and also as *not* having extended to the more solid headlands. He observed:—"On the portion of the field where the attack is the worst, there was no crop last year; it was a dead fallow. The attack has not extended to the headlands, which, from being trod in ploughing, were more solid; also two pieces in the same field were Mangold Wurzles last year, and ten cwt. of superphosphate of lime was sown to the acre; on these two pieces the Wheat plant was very vigorous and healthy, without any sign of the maggot; even the outside rows are not touched."

Mr. Henman further observed, relatively to pressure of the ground:—"It is a good plan, if fallow is sown with Wheat, to put on a

* I beg to acknowledge, with thanks, this report, as being forwarded to me by the Editor of the 'Field.' It is given at p. 742 of the number of the 'Field' for May 16th, 1891.

good heavy Cambridge roller at the time of sowing, but often, as in my case last year, the land was not sufficiently dry, and it could not be done. Fallow is undoubtedly best sown with Oats or Barley."

Mr. W. Creese, of Teddington, near Tewkesbury, who has had long experience of this pest, favoured me with the following observation, which, it will be seen, turns still on the point of the grub following fallow; and in the very same field, and after the very same crop, attack *not* occurring where this preceding crop had been kept on late, so that the ground was protected by it and not fallowed. Mr. Creese remarked:—"When walking over a neighbour's farm, I saw that two sides of a field had failed from the grub. The land had been skimmed, and planted again with April Wheat. A few acres in the middle of the field were spared, and promise a heavy crop. The explanation given me was that the vetches on this portion were kept for seed, and the land was ploughed late, instead of being, as, on the other parts, mown early and the land summer-fallowed."

The following note is still on the same lines of the attack occurring where land has been greatly exposed, even where not actually fallowed, and this also we have had evidence of in previous years. Mr. W. Wiles Green, of the Elms, Manea, Cambs., writing on the 16th of May, mentioned:—"The Wheat-bulb maggot has, I think, now done its worst, and, I am sorry to say, has in many instances left us but a poor patchy crop. The injury, I may say, in most or all cases, is to the Wheat crop sown after Oats." . . . . "My opinion is that the mischief was done after the Oats were cut. It will be in your remembrance that the latter end of August, and for some time then, the weather was very hot and fine, and the Oat crop, being a heavy one, had to be mown very close, leaving the land in some places quite bare."

Mr. Wiles Green further wrote:—"You say, in reference to the attack, that part of some fields only are attacked. I know several cases, this year, where part of the field was sown or planted with Potatoes, and the rest with Oats. The Wheat after Potato is a very fine crop; after Oats, a very thin, patchy one; and the difference is so sharply defined you can see (one may say) to an inch." Also, the remark, "I am somewhat afraid the only remedy we have is not to sow Wheat on land that has the July or August sun shining on it," appears at present only too near the real state of the case.

But (resuming the past season's report) on the 21st of May, Mr. Eardley Mason, of the Sycamores, Alford, Lincs., sent me observations of three attacks in the neighbourhood of Alford. In one at Willoughby, the attack, examined on the 17th May, was then advanced to the pupal or chrysalis state, and a full third of the plants were estimated to have been destroyed. This crop was after a fallow. On the following day, the 18th, in a field at Cumberworth, some of the pests were still to be

found in maggot state, nearly and quite full fed, as well as puparia. Here, again, a third of the crop was considered to be destroyed. This attack was after *mown* Clover, and the crop sown the first week in November, 1890.

A third attack was reported from Helsey on the 19th, but not examined, as the damaged crop had been ploughed up. The previous rotation had been:—1889, Oats; 1890, fallow, crop sown 1st Nov.; 1891, resown with Barley 8th May.

Mr. Eardley Mason added the very noteworthy observation that in all the cases the headlands were not at all, or very slightly, affected.

The following observations, also, by Mr. E. Mason, are of practical value, as showing no *noticeable* presence of the attack in wild Grasses. The remarks as to non-presence of the attack in wild Grasses were in reply to my own inquiries, turning on the point of some of our Corn insect-pests being double-brooded; and that in this case, if, like the "Frit Fly" in Oats and Barley, the spring attack took place in the young shooting plant, and the summer one in the ear, we should thus gain a good clue towards prevention. I suggested Grasses, as these might be found on neglected fallows, or in the noticeably thin crops sometimes preceding Wheat-bulb maggot attack.

Mr. Eardley Mason wrote me on the 24th of May:—"I doubt much whether *H. coarctata* will be found to have a summer brood. The larva is so large that I can scarce believe that the damage caused by the summer-born host could have escaped notice. For the last three years my eyes have been at work detecting injured Grasses in hedgerows and by roadsides. With scarce an exception the cases have been of fungoid disease. In no case has there been an approach to injury like that of *H. coarctata*.

Further on Mr. Mason notes that "It is true that the headlands get the most trampling, and are thereby consolidated; and if it should be the case that the fly lays its eggs in the broken-up soil before sowing, one can understand how many eggs must be so closely compacted as to render the emergence of the larvæ impracticable." . . . . "If the fly lays its eggs in spring, I wholly fail to understand why headlands, and Wheat after seeds, escape."

The following observations were kindly sent me by Mr. William Parlour, of Middle Farm, Dalton-on-Tees, Darlington, regarding some points on which I enquired of him, especially those suggested by the absence of attack on trampled or "firmed" ground, as on headlands. The first observation is as to infestation in spring-sown Wheat:—"I have never known of the maggot being found in spring-sown Wheat, but I have had very little opportunity of observing, for the quantity of Wheat sown in the spring in this district is very small indeed."

The second observation gives some remarks on rolling, and also on there being possibly some confusion between effects of maggot and of frost on the young plant; and this point is also alluded to in the communication by Mr. E. A. Fitch, given below.

Mr. Parlour observed:—"With regard to your second question, it is not usual to roll land in autumn, and I have never known an instance of it; but, rather strangely, I find on enquiries that it was the universal custom fifty years ago to roll fallow land in the autumn, after it was sown with Wheat. The reason given for this custom was that it prevented the Wheat from being 'turned out' by the frost. Now as to this 'turning out:' I have visited many fields that were said to have been 'turned out,' but I found *in every instance* that it was the maggot, and not the frost, that had done the damage. I do not say there is no turning out because of frost, but there is not nearly so much as is generally ascribed to it. Is the foregoing sufficiently connected to enable us to come to the conclusion that the pest was in existence fifty years ago, and rolling in the autumn was resorted to, to prevent it? Scarcely, perhaps; it would be going too fast; but it is as well to keep this in mind for a time."

The following notes, from Mr. E. A. Fitch, of the Brick House, Maldon, Essex, refer to various of the foregoing points, and are of some special interest regarding technical insect observation, as, besides being an agriculturist on a large scale, Mr. Fitch is an entomologist of old standing, and was at one time Secretary of the Entomological Society. Mr. Fitch wrote me on the 9th of June:—"This white maggot has been very troublesome on our Essex heavy land this year, and much that has been said to be winter-killed has, I believe, really suffered from this pest. Mr. Frank Page had twenty acres of Tare-etch Wheat; the Tares had been fed off, and where the field was first folded, and consequently first ploughed and longest fallowed, the attack was very bad, and in less intensity over the field, until the side sown with spring Tares, and only ploughed for Wheat once, not fallowed at all, was hardly touched. The rest had eventually all to be ploughed up, and in the earliest ploughed (last year) land hardly a blade was left. This is interesting, and looks as if the tilth of the land had something to do with it; it is always worst on fallow or Tare-etch Wheats than on Wheat after Beans, Peas, or Clover. I have enquired, and there are no changes in rolling practice; we have never rolled our Wheats except in spring, or, for the matter of that, any other land."

Summary.—Looking now over the notes of the past season, in connection with those of previous years, it seems to me that though we have not advanced to certain knowledge (that is, knowledge from absolute observation of the maggot itself in the ground) of where the

infestation lies in autumn, or how it begins its attack on the young Wheat, yet that we have got a strong clue.

The point which we have wanted to make out throughout the years of observation has been, *is there a summer brood?* It appeared against all likelihood, and contrary to all common insect habits, that the flies, that came out in July or earlier, should remain alive and without egg-laying until the time of the sprouting of the autumn or early winter-sown Corn. Therefore we needed to ascertain whether there was a second brood, of which the flies came out in autumn, in time to lay eggs by the young Wheat. Failing these, there appears to be no possible cause for this bad infestation, excepting the presence in the ground (in autumn or winter) of eggs, or of maggots hatched from eggs, deposited by the flies which we know come out about July. This, it appears to me, from collation of observations, *must be the case*. We can put the matter to practical proof presently, but meanwhile I think it will be considered, from the following observations, that any other method of infestation appears, so far as our information up to date goes, *most unlikely*.

First, about non-observation of second brood. In Mr. J. Eardley Mason's notes (p. 36) we have the report of a pratised observer, and one well acquainted with Wheat-bulb maggot attack, who, though carefully watching the condition of Grasses for several years in a Wheat-bulb fly infested district, yet never saw, amongst the various forms of disease which he noted, any instance of presence of this attack, namely, that of the *Hylemyia coarctata*. No one has ever reported it in this country (or, as far as I am aware, any where else) as being found in any part of the summer and autumn Wheat, or other Corn crops, and therefore, if it is unknown both in Corn and common Grasses in the summer (meaning by this the later part of the summer after the first brood has come out of the ruined spring plant), this gives a very strong presumption that a second or summer brood does not exist. Therefore, that autumn attack is set on foot not by *flies* laying their eggs on the young sprouting Wheat, but by *maggots* hatched from eggs laid in the ground earlier in the year.

This view is confirmed by the very peculiar customary limitation of the area of attack to land which in the previous summer has been under special conditions. It is very well known that where maggot attack occurs it is usually after fallow, or on land that has been much exposed to the sun. But besides the broad-scale observation of this, as in whole fields, or fields of a whole district, it may be shown as occurring almost to a line in portions of fields. We can point to small *attacked* patches where ground was left bare by failure in a previous crop; again, we can point to a strip across a field being *free from attack* where this part was *protected* by a crop which was ploughed late,

whilst there was an attacked part on each side where the crop had been removed early and the ground summer-fallowed. Also, in the very useful note given by Mr. E. A. Fitch, we have an account of a twenty-acre field of Tares, which was fed off, and on the part where the land was first folded and ploughed, and therefore longest fallowed, the attack was very bad, but went on over the field with less intensity, until, on the side not fallowed at all, the maggot hardly did any harm (see p. 37).

All these observations seem to point strongly to the attack on the young sprouting Wheat not being from the fly laying eggs on it, but from maggot in the ground. It seems beyond all probability, or anything that we have precedent for, to suppose that in a field of Wheat, of which the whole was sown at the same time and under similar conditions, the *flies* would leave or choose portions, almost to marked lines, where the whole crop would serve them equally for food.

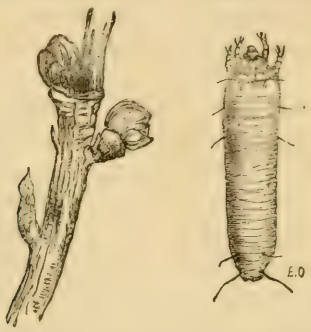
But with the maggot the matter is quite different. If the eggs were laid on the exposed land, or not laid on the protected land, there (accordingly) would be presence or absence of maggots, and we thus appear to me to reach to the probable explanation of cause of attack.

The non-appearance of the infestation on the trampled headlands, as observed by several correspondents, points in the same direction. In case of the fly laying her eggs *subsequently to ploughing*, there does not appear to be any reason why the attack should be worse here than in the field. But if the eggs, or the maggots, were there, the trampling and compacting the soil might be well believed to lessen their amount.

Whether the above views are the correct ones remains to be proved, but these alone would explain the peculiarities of the attack, which have long been well known, and would reconcile all the conflicting points. One of the best methods of proving the views which occurs at present, would perhaps be ploughing with skim-coulter, attached so as to turn down the uppermost (and probably maggot or egg-infested) surface, and bury it well away beneath the deeper land slice, which would be laid on the top. This might easily be tried first on a small scale, say on an acre or so, where there was likelihood of infestation being found; and if absence of attack followed in an otherwise infested field, we should have gained most useful information. At present our only really well-founded hope of escaping infestation, in districts where the attack is commonly prevalent, appears to be not sowing Wheat after summer fallow; but if the maggot proves to be in the ground, then the way would at once be open to prevention of attack by various forms of dressings, or ploughings, or, in some instances, where nature of the soil allowed, by rolling or sheep-treading to compact the soil.

CURRANT.

Black Currant Gall-Mite. *Phytoptus ribis*, Westwood.



Phytoptus infested buds; *Phytoptus* (? sp.), enormously magnified.

The attack of the Black Currant Gall-Mite was again reported as occurring at various localities in the early part of the year, from February, when the buds were first beginning to show the peculiar swelled growth which distinguishes those attacked by the Mite from the natural form, up to the middle of April or beginning of May, when the work was in progress of removing the "galled" buds from the infested shoots. These round diseased masses of abortive growth, like small balls of green leaf-scales, may be about the size figured above, but often twice that size or more, and on opening them they will be found to contain (probably in great numbers) the minute "Gall-Mite" which has caused their growth. This is too small to be discernible by the unassisted eye, but with magnifying powers will be seen to be of the long narrow cylindrical shape figured above. It is furnished, throughout its life, with two pairs of legs, placed near the head extremity. This, it will be seen, is a little enlarged before it narrows rapidly into the somewhat snout-like or bluntly pointed proboscis. The Mite is also furnished with a few long bristles, and is hatched from an egg.

This attack has been so frequently alluded to, that it seems unnecessary to repeat the descriptions of the attack sent in from different localities during last season; but it may be observed that the infestation is one which is troublesome and wasteful enough, even on the small scale of private Currant growing, but where this is multiplied by acres, as in the regular Currant plantations, the losses, consequently on failure of crop first, and afterwards from injury to the health of bushes of which the leafage is thus checked in development, are very serious. The attack is now widespread, and is certainly to

be found at localities from Devon to near Glasgow, and possibly further north.

On the 16th of April, Mr. C. D. Wise wrote me from the Toddington Fruit Grounds, Winchcombe, Glos.:—"I am having the *Phytoptus* picked off our Black Currants, and I am sorry to say the women pick *baskets full.*" This trouble is well worth while, because thus not only the "Gall-Mites" themselves are got rid of, but also vast numbers of eggs, which would soon have sent out new supplies of infestation. Amongst specimens sent me on the 4th of April from Hanbury, near Droitwich, I found the minute white eggs in various stages of development; some still round or roundish, and others pushed out of shape at one end by the pressure on the thin egg pellicle of the bluntly-pointed head of the Mite within, the locality of the legs of the Mite being also indicated by little knobs, showing the position within of what might be called the shoulders.

So long as the buds are infested by scores or hundreds of Mites, and their eggs remain on the bushes, it does not appear likely that much good would be done by applications of either fluid or dry dressings, for the Mites would, for the most part, be protected within the sheltering gall leaves. But when all the propagating colonies were removed and destroyed, it might be hoped that soft-soap and sulphur wash (or any other kind preferred) would do great good by destroying all Mites that were travelling on leaves or stems of the bushes.

Each grower should follow his own experience as to wash that may be useful, but I should incline myself to trial of the soap and sulphur wash introduced in the past season by the "Chiswick Soap Co.," Chiswick. This is made somewhat, though not exactly, on the lines of the mixture known in South Australia as "Burford's Compound," which was especially recommended by the late Mr. Frazer Crawford (Government Inspector in South Australia under the Vine and Fruit Protection Act, and a most excellent authority) for use against *Phytoptus* attack. Various forms of application of sulphur wash have been advised, as of sulphur and lime, also of sulphuret of lime with soft-soap; * but one advantage of the soft-soap and sulphur compound of the Chiswick Co. is, that after it has been mixed with water, and allowed to stand from sixteen to twenty-four hours, the sulphur dissolves, and thus a serviceable wash is attainable without any special arrangement for solution of the sulphur. The requisite strength should of course be tested before use on a large scale on different ages of leafage, but when properly managed I have found, in my own garden, that even the delicate early spring leaves of Peaches and Apricots were quite uninjured by spraying with the compound.

* See my '9th Report on Injurious Insects,' p. 35.

When the attack has once settled on large Currant grounds, it is most difficult to get rid of it; but a watchful eye, and prompt measures of extirpation on the first sign of its appearance, will do much to keep it out; and the following note, with which I was favoured by Mr. J. Wright, Assistant Editor of 'Journal of Horticulture,' gives some very useful suggestions :—"About twenty-three years ago this Mite suddenly took possession of a Black Currant bush in a garden, then in my charge, in Lincolnshire. The next season *all* the buds were knobbed. The following season it ruined one side of the next bush. I did not know what it was, but saw it was ruinous, therefore chopped the two bushes level with the ground, burned them, and threw a shovelful or two of lime on the stumps and soil. Fresh growths pushed and grew into bearing, and quite free from the Mite."

Parasites.—During the past season specimens of two kinds of parasitic insects, found in the *Phytoptus* galls, were sent to me by Mr. W. Gibbon, of Seaford Grange, near Pershore, Chairman of the Evesham Fruit Growers' Experimental Committee; and their presence suggests the hope that with the increase of *Phytoptus* disease, the increase of Mite-feeding parasites may be following in its train.

On the 20th of April, Mr. Gibbon wrote me that he remarked that in the Black Currant gall, or knob, a white milky-coloured worm or grub, one-eighth of an inch in length, would be found with *Phytopti* all about and around it. This grub, Mr. Gibbon noted, he could not find had been observed by others, and he sent me a specimen (with the *Phytopti* still all about it) carefully secured between two pieces of glass.

On examination I found that this was certainly the maggot of some kind of two-winged fly (a *dipterous larva*), and the accompanying circumstances seemed to show clearly that it was not merely a co-tenant feeding together with the *Phytopti* on the vegetable matter of the bud-gall, but was a carnivorous larva feeding on the *Phytopti* themselves.

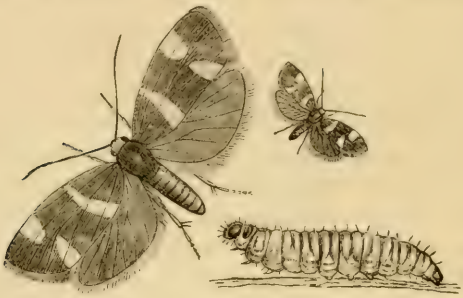
Mr. Gibbon had placed the maggot and *Phytopti* between two glass slides, so carefully fastened together that I had some difficulty in cutting them apart; there was therefore no reason to suppose that the *Phytopti* could have escaped; but on examining for what might be present (before separating the glasses), and both with a two-inch and one-inch power, no *Phytopti* at all were to be found. After separating the slides, and again examining with a one-inch object-glass, I still found no *Phytopti*, but I was very much struck by the condition of the fly maggot. Instead of being shrunk and empty, as might have been expected, from starvation during the time of its postal transmission, things were quite otherwise. It was observably swelled out with food, and this not mere juice, but of such a solid nature that I was able to

remove it on to the glass slide. From this it appeared hardly possible but that the fly maggot must have consumed its fellow passengers on the journey; and if so, the fact of there being a carnivorous grub co-operating with us in keeping down the Mite pests, is one which it would be well to trace onwards to the development and identification of the perfect insect, and then to consideration as to how its presence might be multiplied. This I suggested at the time to Mr. Gibbon, who took much pains in the matter, and though not successful in developing this special parasite, or apparent Gall-Mite feeder, his observations were perhaps still more valuable by showing the very numerous presence of another parasitic insect enemy.

On June 17th, Mr. Gibbon forwarded to me, by careful hands, a glass (still unopened) in which, secured beneath the cover with the galls from which they had developed, were what proved on examination to be a large number of minute four-winged flies. This being at a time when I was unfortunately too ill, from a severe attack of the influenza then prevalent, to attempt to identify them, I forwarded them to the better-skilled hands of Mr. O. E. Janson, who told me they were Chalcids, but as yet we have not obtained identification as to the species. The *Chalcididæ* are a family of Hymenopterous flies, usually parasitic, and usually of brilliant colour, with four almost veinless wings.

In the case of *Phytoptus* attack, there do not appear to be either the difficulties or the objections in the way of rearing the parasites which occur where the host is an insect and is very similar in size and appearance with its tenant. As the *Phytopti* cannot fly, there is no danger of them being dispersed together with their winged parasites. No greater care would be required for rearing than (when the infested galled buds were picked from the shoots) to throw these galls where they would be in fairly natural circumstances. They should be only thinly sprinkled over the surface where they are thrown, in order that they may not mould, and also that the Chalcids as they emerge may be able to fly freely away. They should not be exposed to a drying sun, nor to be soddened by rain, nor to be at the mercy of the small insect-feeding birds. Nor yet should they be where the Mites can get back to the bushes. Probably a space on the floor of an open shed would answer well.

"Currant-shoot" Moth. *Incurvaria capitella*, Fab.



INCURVARIA CAPITELLA.*

Moths, magnified and nat. size, from life. Caterpillar, magnified, after Stainton.

The *Incurvaria capitella* is a small moth which, so far as I am aware, has no special English name; but as the caterpillars are injurious by feeding within young Currant shoots, perhaps the name of the "Currant-shoot" Moth would distinguish it fairly well.

The moths figured above were sketched from a specimen of the *I. capitella* kindly given me by Mr. T. Doeg, of Evesham, who bred the insect from larvæ taken in shoots of Red Currant, on the fruit plantations belonging to the Toddington Fruit Company, in Gloucestershire. The little moths are about five-eighths of an inch across in spread of the fore wings; head with a thick tuft of ochrey hair above. Fore wings dark brownish or fuscous, sometimes with a purplish satiny gloss, a pale yellow band across the wing at about one-third of its length from the root, and two patches, also pale yellow, about half-way between the yellow band and the tip of the wing: these two patches are respectively on the fore and hinder edges of the wing, and the hinder patch is somewhat triangular in shape. The hinder wings pale grey.

The note of habits of this moth given in Stainton's 'Tineina' is:—"Common among Currant bushes at the end of May. The larva is very injurious, eating the pith of the young shoots, and betrays its presence by the withering of the young leaves when quite young; it is dark red, but when full fed it is greenish white."

In the 'Pflanzenfeinde' of Kaltenbach, p. 260, a little is added to this information:—"The larvæ (according to Stainton and A. Hartmann, of Munich) live early in May in the young shoots and buds of

* The neurations of the wings only show partially so long as the plumage remains. To display this characteristically the scales must be removed. This is well shown by various comparative figures of wings, denuded and undenuded of scales, given in Stainton's 'Tineina,' plate 2.

the *Ribes rubrum*. These they devour even to the pith of the twig. The moths fly about the Gooseberry bushes" (Stachelbeer-straucher) "in the morning hours."

The caterpillars of the *I. capitella* are an exception to the other kinds of *Incurvaria* in respect that they feed in Currant twigs; whilst of the other species, "The larvæ live in cases formed of pieces of dead leaves, and feed on the fallen leaves during the autumn and winter." * Still it may be open to doubt whether this point does not need enquiry; for in Kaltenbach's remarks, before quoted, he mentions the winter-cased caterpillars of the *I. capitella* being found about Beech trees. If this is so, they might prove on examination to be also about the Currants, and we might thus have a means of clearing some of the infestation. And it will be seen in the following observations, with which I was favoured by Mr. C. D. Wise, of observations of the attack in the Fruit Grounds at Toddington, Gloucestershire, that he also thinks it possible that chrysalids may be found in the earth beneath the bushes.

Mr. Wise wrote me that "about the 20th April we noticed numbers of the young shoots of the Red Currant bushes had withered up and drooped. On examination we found in each a small grub which had bored its way up the stem." Specimens of the moth reared from these caterpillars, from one of which the illustration at p. 44 was figured, proved the attack to be of the *Incurvaria capitella*. Of this Mr. Wise further remarked:—"The moth hatches the end of May and early in June, and from our observation we are pretty sure that the caterpillar turns into chrysalis in the earth beneath the bushes. The remedy we adopted for this pest was to pick off the infested shoots and burn them, which of course means a lot of labour; but what else were we to do?"

* Stainton's 'Tineina,' p. 40.

FLOUR MILLS AND STORES.

Mediterranean Flour Moth. *Ephestia kühniella*, Zeller.

EPHESTIA KÜHNIELLA.
Mediterranean Flour Moth, magnified; outline showing natural size.

The attack of the Flour Moth continues steadily to spread, and as, besides other localities, I am aware of it being present in Yorkshire, Cheshire, and Carnarvonshire, it may be considered to be fairly established in the country.

So far as appears at present, this spread will go on until the losses from the fairly overwhelming nature of the infestation, where it is once permitted to establish itself in Wheat mills and stores, so absolutely *force* it on attention, that the nature of the attack will be known at a glance, and protective as well as remedial measures be brought to bear.

At present, so far as I may judge from applications to myself, millers suffering under this injurious attack naturally keep the matter as quiet as they possibly can; and enquiries which I receive on the subject being in business confidence, I am unable to give the requisite cautions in the neighbourhood of infested premises. But though it is a matter of great difficulty and expense to clear a mill where the pest has once made good its entrance, still much might be done by other millers, store and warehouse owners, bakers, householders (in fact by all purchasers or holders of Wheat flour), being on the alert as to the condition of the consignments sent them, and also of their own returned sacks. In one instance reported to me, where this moth (duly identified) "swarmed," the millers stated that it first came in some returned empties (sacks). They noticed these grubs at the time, but "did not consider them of any importance." All Wheat-flour millers should have such information accessible as will enable them to recognise this pest when they see it.

The moth is of the shape figured above, and of the size of the figure in outline; the colour of the fore wings rather pale grey, with darker markings; the hinder wings whitish and semi-transparent.

The grubs or caterpillars, when full grown, are somewhat over half

an inch long, and, as seen without the help of a magnifier, almost white, when younger of some tint of flesh colour or pale red, and are slightly sprinkled with pale hairs or fine bristles. Feet sixteen in number, that is, three pairs of claw-feet (one pair on each of the three segments next the head), four pairs of sucker-feet under the body, and another pair beneath the tail. The markings by which this kind of caterpillar may be distinguished, with the help of a hand-magnifying glass, from other kinds are as follows :—Head yellowish brown, darker in front, and with dark brown jaws ; a transverse patch on the segment next the head, this rather pale yellowish brown, with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch. Along the back, excepting towards the head and tail, were four small dark dots on each segment, above, two on each side the centre. On the segments near the head the spots were arranged more transversely, and at the tail, immediately above the sucker-feet, was a brownish oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat in different specimens ; the largest was in the middle, with a smaller one on each side, occasionally one below, which would make five altogether ; but sometimes the lowest pair was absent, sometimes the middle large spot was not entire ; conjecturally the marking differed with the age of the caterpillar. On the preceding, that is, the eleventh segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment. When full grown the caterpillar changes to the chrysalis state (in the instances I have seen) amongst the spun-up flour, but I am not sure whether it is always in a silken cocoon. This chrysalis showed the shape of the future moth very plainly, and was peculiar both in shape and in colouring. It was the colour of bees-wax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged slightly curved tail, which ended bluntly or cylindrically ; the eyes were of a darker shade of red.

In the Canadian observations it is noted that " When not hidden in a package or deposit of flour, the larva has a habit of retiring to some crevice before passing the chrysalis stage ; consequently they are to be found in innumerable places quite impossible to be reached by any brushing-down process."

I have not myself ascertained how long the chrysalis state lasts. Prof. Zeller notes that the moth comes out in about three weeks.

From the various dates at which moths and caterpillars have been observable, this pest appears an all-the-year-round infliction.

The mischief is caused by the caterpillars dispersing themselves over every part of a mill, or its machinery, where the Wheat flour can

be found,—whether in spouts and machinery, where they do no end of mischief, both by destroying the silks, and stopping the flow of flour in the spouts by spinning thin webs and hanging thereby,—" or by getting into all crevices and every cranny where there is flour to feed on." One characteristic point of the damage is the manner in which the caterpillars spin the flour (amongst which they feed) together with fine webs, so that it may be picked up in lumps or clots. The speed and thoroughness with which caterpillar possession is or may be taken, is shown in the various extracts from the 'Canadian Report,' before referred to, which are given in the following pages.

It is not, however, only in open parts of mills or their machinery that the pest is located. One of the very first observations of it in this country was in connection with flour in sacks. In 1887, Mr. Sidney Klein noted an attack in some large London warehouses where there were over a thousand tons of flour stored, and one entire warehouse was literally smothered with larvæ, and several hundred pounds worth of damage done.*

In a letter to myself, Mr. Klein noted they were not in the grain, but only in the flour, and especially in any light fluffy or branny stuff, and especially remarked, " My impression is that they have come to me from some baker in returned empty sacks." Further, in his paper before quoted (read to the Entomological Society), he mentioned that the eggs, which seemed to be laid by the moths " generally upon the top of the sack, hatched in a few days of being laid; and the larvæ, (caterpillars) at once burrowing through the sacking, commenced spinning long galleries in the flour, seldom, however, going more than three inches from the exterior."—S. T. K.

When the attack was first brought under my notice in 1888, I suggested turning on steam. This was done, the mills were stopped for a week, the machines were cleaned, and steam was applied by carrying about forty yards of half-inch piping into the mill from the boilers, and attaching an india-rubber bore to it, for the men to work about on the walls, floors, spouts, and machines, blowing the steam into all crevices and holes. This was followed up by washing the inside of the machines with strong boiling solution of soda and water. It was found that strong soda and water destroyed the maggot where it could be applied to them. Walls were whitewashed, and paraffin applied wherever it could be done without affecting the flour, even to syringing likely places for the moths to settle in, and for the time much good was done, but even with all the above expense and labour the attack was not cleared, and recurred to give further trouble.

* See paper by Mr. Klein, read before the Entomological Society of London on Nov. 2nd, 1887.

On the outburst of the attack in 1889, in Canada, the matter was taken up by the Department of Agriculture of Ontario, and the measures adopted by the Steam Milling Co., on whose premises the attack had first been observed, being deemed insufficient, the steam treatment was improved on, under Government orders, by construction of a strong room or box, so arranged that steam under pressure could be drawn or driven into it. This box was six feet wide, six feet high, and twelve feet long, and a steam-pipe was attached to it from the boiler; and in this box every machine, and even the mill-stones and iron rollers, were submitted to purification from the infestation, by steam.

The result was, as stated in the Appendix (published at Toronto, on Oct. 15th, 1890) to the preceding 'Bulletin' on the Flour Moth,* "The measures which were taken by the Provincial Board and the Milling Co., on whose premises the moth appeared last year, have, I am glad to say, resulted in a complete eradication of the pest from such premises."—P. H. B.

This Appendix, which is addressed to "millers and produce-men," in view of important interests involved, and the loss likely to accrue to the export trade of the province (if the pest became prevalent), drew attention forcibly to the penalties there attached by law to any violation of the statute regarding selling unsound grain or flour. Further, they gave notice of the course they purposed to adopt in case the owners of infested premises had "so little regard for the public interests as to send sacks infested with the ova or larvæ of the pest to other places."

In regard to legal points: that in no way enters into our present consideration here, save to show the great importance attached to stamping the pest out immediately; but the measures to be taken for this purpose, which are given in the same 'Bulletin,' are well considered on good authority, and those which I reproduce below are applicable here as in Canada:—

"1. Destroy the moths. This can be done by closing the windows, doors, or other apertures of the building, and, night after night, until all evidences of the moths have disappeared, burn sulphur by placing it in shallow pans upon a number of heated stoves, say small coal-oil stoves, in different parts of the building, and putting a match to it.

"2. Search for evidence of larva or caterpillar in all packages, bags, &c., of flour or meal, and, wherever found, at once superheat the flour in a dry kiln. Spread it out in a thin layer, so that the heat can reach it and the packages, boxes, &c., containing it.

* Appendix to 'Bulletin' 1 on the Flour Moth, issued by the Ontario Dept. of Agriculture, prepared by P. H. Bryce, Sec.

"3. Under no circumstances sell this material to other dealers, whether to mills or produce-stores, but have it treated with boiling water or steamed, and fed to pigs.

"4. Where webs have appeared, either in the packages of meal and flour, in the bolting-cloths and carriers, or in deposits of dust on ledges, along the walls, &c., it may be deemed certain that the larva has taken on the chrysalis stage. Hence it becomes necessary to make a close search in all these places for the cocoons, or little masses of flour glued together, of say three-quarters of an inch in length. These swept down can readily be gathered up and burned.

"It has, however, been already pointed out that, owing to the habit which the larva has of retiring to some crevice, when not hidden in a package or deposit of flour, before passing into the chrysalis stage, we find them in innumerable places quite impossible to be reached by any brushing-down process. Two ways only are left for overcoming this difficulty. The one that first suggests itself is that of waiting till the chrysalis is burst and the moth appears, and then kill the moth.

"This doubtless may be followed by good results, *i. e.*, have the first moths appearing destroyed by hand, and by subjecting the affected portions of a mill or building to repeated treatment with the fumes of burning sulphur every night when the works stop. If this is persistantly followed out, but little development of new forms will take place. It must be remembered that this work must be persistent and thorough; abundance of sulphur, burnt again and again, being the sufficient condition of success.

"Where, however, the larvæ have, as it were, gained possession of bolting-cloths and carriers, treatment with steam under pressure driven throughout all parts of the bolting-cloths, carriers, and other machinery, has been found very useful in lessening the inconvenience from the spinning of webs, and thereby the clogging of the machinery. The walls, floors, and ceilings may further be treated with advantage by first brushing down all dust, and thereafter spraying them with a solution consisting of a drachm of corrosive sublimate to each gallon of water, by means of a gardener's force-pump. Treatment by fumes from burning sulphur while parts are yet moist from this washing-down, will greatly aid the destruction of any larvæ or cocoon forms which may be reached."—See 'Bulletin,' pp. 12–14.

"*Note.*—To prepare sulphur fumes: place a metallic dish containing hot ashes on some support in a pan of water, or place in an old pan or other vessel a bed of ashes, at least six inches deep and about fifteen inches in diameter, and place the sulphur and saltpetre in a slight depression in the centre and ignite. The proper proportions are three pounds of sulphur and three ounces of saltpetre per thousand cubic

feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited."—'Bulletin,' p. 12.

Precaution necessary in fumigation.—In application of sulphur fumes, it is very necessary to attend carefully to amount that may be safely used, or great loss may ensue consequently on alteration in the nature of the flour through effect of fumes making it unfit for use.

In an instance brought under my notice, very heavy fumigating was carried out during three days when holidays, following on Sunday, allowed work to be suspended. In these three days, five hundred pounds of sulphur were burnt on two fires. The result was, as reported to me, that, there being eighty or one hundred sacks of flour left standing in the mill, the sulphur "penetrated right into these, and acted on the gluten of the flour in such a manner as to apparently break it up into soluble albuminoids, and render the dough made from it more like a lot of weak putty than the 'strong' dough our customers require."

Regarding this injured material, the chemist, in whose hands a portion was placed for investigation, wrote me as follows:—"I am engaged in examining samples of the damaged flour, which seems irremediable. But the right treatment would certainly seem to be exclusion from mill during fumigation of all flour and Corn, and repetition of the fumigation at least once a week until a cure is effected, the sulphur being used in indicated quantities. Only a manufacturer can appreciate the trouble and expense of such interruption to regular systematic mill-working, but there can be no question of the absolute necessity of taking prompt steps, whatever the trouble may be."—(W. S. C.)

If it were possible to alternate the grinding of other flour material with that of Wheat in infested mills, remedial measures could at once be carried out; but where neither the arrangements nor the delicate machinery of modern Wheat-milling allow of this, we are thrown on necessities of *skilled care* in preventing admission of attack, and the very troublesome remedial measures if it does get in.

The following notes, sent me on the 23rd of Oct. by a miller, from a district which I had not previously heard of as infested, show just the same characteristics of attack. Specimens had a short time before been sent, which the miller noted as "of a certain moth which has caused a great amount of inconvenience to the flour mills of this country during this year." He further mentioned that the chief source of inconvenience was due to the silky tissue, "which links, or rather gathers, together flour and other stock, forming a sponge which sometimes assumes such proportions that spouts are actually blocked up. They are also a trouble at the feed rollers, as they make the feed

to roller mills and other machines uneven, and might at such a point do vast injury to the plant."

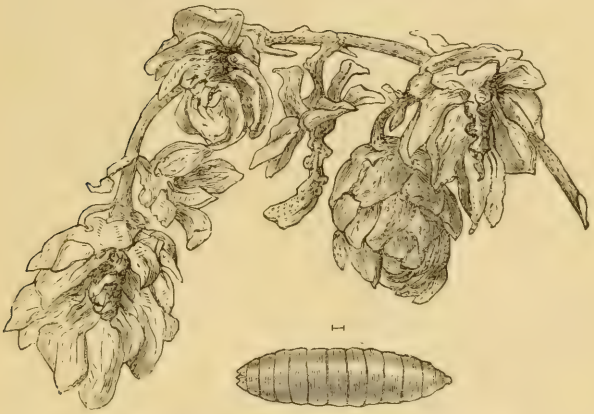
Unless the appearance of the pest in its different stages, and also the peculiar felted-up state of infested flour, *are known*, the attack cannot be properly fought; and in the foregoing paper I have endeavoured to condense what appear to be the most important points bearing on the subject, which have been brought forward since the first appearance of this mill trouble (in this country) in 1887. Details of the method of attack, and the means found of more or less service in prevention, will be found in the 'Bulletin' on the "Flour Moth," bearing date Oct. 19th, 1889, and the Appendix to the same of Oct. 15th, 1890, issued by the Department of Agriculture, Ontario, Canada; and in my own 12th, 13th, and 14th Annual Reports on Injurious Insects, in the first of which are references to some more purely entomological observations.

It is well known to all suffering under the pest how much some more information is needed as to remedial measures, and the above notes are only given as leading points in how far we have advanced at present, and also in the hope that those who know more may come forward and help by additional information, which would be a great public benefit.

I should be happy to receive anything sent to myself for publication, and meanwhile have had a separate impression of fifty copies of the foregoing paper printed for gratuitous distribution to any applicants practically interested in the subject.

HOP.

Strig Maggot. *Cecidomyia*, ? sp.



Hop catkins, showing effect of infestation; Strig Maggot, mag.; nat. length given at page 55.

The attack known as that of the Strig Maggot has long been known of as causing much damage to the Hop-cone or catkin, but it was only (so far as I can find) in the past season that we have been able to trace this attack with certainty to being caused by the larva of a *Cecidomyia*, or Gnat Midge, the maggots being therefore very nearly allied to the well-known "Red Maggot," which often causes much damage to Wheat.

In 1882, notes were sent me by Mr. Goodwin from near Sevenoaks, in which he mentioned that the attack had been very general in that neighbourhood, and had ruined several pieces of Hops. He observed that the "maggot pierces into, or rather is bred in, the 'strig' or stalk of the cone or flower, where it eats its way up the inside of the stalk, which causes the Hops to wither and turn brown." One or two maggots were the average number present, and in the early part of September these were very numerous; but later on, by Sept. 27th, they had disappeared, and it was observed, "they drop out into the earth after eating the Hops." Mr. R. Cooke, of Detling, near Maidstone, also forwarded Hops similarly injured, observing that the altered colour was from the attack of a maggot which burrowed in the central stem, and that the infested Hops began to go off from the tips, the stem which supported them dying back to the main branch.

With all the specimens sent, however, I did not succeed in finding a single maggot present; therefore had no clue to the cause of the

mischief. In the following year (1883) specimens again sent me by Mr. Goodwin on the 31st of August (a date earlier than that named in his observations of the previous year) showed the mischief to be caused by the maggots of some kind of small two-winged (*dipterous*) fly. The "strigs" were tunnelled by the maggots, and on laying the Hops on a table the little maggots came out of them, and joining head and tail, like Cheese Maggots, skipped in all directions. Still, there being apparently no recorded description of this kind of attack to Hop, and also as I had not then the strong microscopic powers which I since procured, I did not manage to identify the larva; and no further specimens were sent me until the past season, when I was able to determine the larva with certainty as being that of a *Cecidomyia*.

The first samples sent me were forwarded on September 22nd, from The Parsonage, Cobham, near Gravesend, by Miss E. J. Stevens, with the remarks:—"I am writing to ask whether you can tell us of any remedy for an attack of Strig Maggot in Hops, or anything which could be used to prevent it another year." . . . . "My father has had the Hop-ground for the last fifty years, and it is only the last two or three seasons the maggot has been troublesome. This year it is worse than it has ever been. We burnt most of the bines last year, instead of wisping them, thinking that might make a difference, but the maggot seems to leave the Hops before the healthy ones are ripe. The Hop-ground is well cultivated; farm-yard manure is used. There has been very little mould this summer, and sulphuring has only been done twice, about 40 lbs. per acre of flour of sulphur each time."

The bunches of Hops sent were undersized; some of them were pale green, some partially discoloured, and some wholly brown.

On investigation I found that in many cases the central stem of the bunch was destroyed, or partially destroyed, and apparently tunnelled by some enemy which for the most part, judging by the small perforations in the outside of the destroyed "strig," had finished its work by making an exit-hole and escaping.

On careful examination I found several kinds of small insects present, but of these the only specimens which could with any certainty be supposed to give rise to the injury were various larvæ of some species of *Cecidomyia*. These were of various tints, from white to a creamy colour, and of the usual form of this kind of maggot—that is to say, long, cylindrical, and pointed at the head end, and furnished near this extremity beneath the body with the peculiar process known as the "anchor process," or "breast-bone."* This was bifid at the free extremity, the points of the fork blunt, and the portion immediately below this with a slight inclination to a bulb shape, the stem rather slight and narrow. Most of the maggots were free, so

* For figure of a *Cecidomyia* maggot, see also paper on Tare Cecids.

that it could not be told whether they were feeding on the part where found; but in one instance, where the portion of the short attachment of a separate flower to the central stem of the bunch (or strig) was only partially injured, I found one of the Cecid maggots lying within, with a narrow stripe of bright green colour running partly along the central line, and showing through the white transparent skin.

This clear evidence that the Cecid maggot absolutely feeds on the juices of the strig, joined to the observation of the great numbers present, appears to show beyond doubt that we have here the obvious cause of the Strig attack.

Samples of infested strigs were also sent me from Knight's Place, Rochester, on the 24th of September, by Miss C. E. Pye, who remarked:—"I am sending you, by my father's request, a few Hops which have been damaged by the insect which eats the stem of the Hop. It has done us a great deal of damage." And information was asked as to the nature of the pest. On examination I found minute white maggots. On breaking one central stem I found two within, in another I found one, and others dropped from the diseased cones.

The damage consisted in the central stem of the cone being so destroyed by the attack that the outer rind and the central longitudinal fibres were much separated, and this attacked portion decayed, as did also the short side stalks of the separate flowers. Thus the "strig" became a mere dead and decayed mass, showing tunnels and cell-like cavities caused by the injury from the feeding of the maggots, or by the thin rind over the injury splitting away from the central fibres.

The maggots had certainly power of skipping, for I noticed one or two in the act of thus changing position, and constantly during progress of examination I found the maggots had left the spots where they were noticeable a short time previously. They varied a good deal in size; the average length was about one-sixteenth of an inch, but they ran a good deal both smaller and larger. The "anchor process" beneath the head end of the body of the larva was plainly noticeable. This was deeply and somewhat bluntly bifid at the free extremity, and had a rather long and slight stem. The Hop-cones were stunted and small, and broke up easily, from the destroyed condition of the central stem.

Specimens of the same infestation were also sent me by favour of Mr. Matthew Bell, of Bourne Park, Canterbury, from the Hop-grounds at Chelham Castle, also near Canterbury; and in these, as well as in those above noticed, the deeply bifid anchor process was clearly observable. Mr. Bell mentioned that he forwarded these as a sample of Hops which were infested by a minute grub which eats the core of the Hop so that the leaves of the cone all fall off, together with some

notes regarding them sent by Mr. W. Butt from the Estate Office at Chelham Castle. At this date (the end of September), judging from reports or samples sent me, the maggots were leaving the Hops; and Mr. Butt noted that some of the maggots would be found concealed in the stem of the Hop, but that they were somewhat difficult to find. In most of the Hops which he picked he could not discover one, although it was easily seen that one had been in the Hop. He noted that in two Hops he had found a couple of maggots in each, and in another (forwarded) there were three, and that the maggots showed very distinctly if they were turned out on white paper, they being of a bright reddish orange colour, and likewise observed that he could not feel certain as to whether "they could crawl from one Hop to another or not." This is a rather important point, which could be ascertained by observation earlier in the year, before the maggots were leaving the Hop-cones for their winter-quarters.

On the 30th of September, Mr. Edw. Goodwin, writing from Canon Court, Wateringbury, Kent, forwarded me specimens of Hops which, from the state of the centre of the cone, had evidently suffered from attack of the Strig Maggot. Mr. Goodwin remarked, regarding this attack of the "so-called Strig Maggot":—"It seems only to appear in very wet seasons; last year it did a good deal of harm, but this year the mischief caused by it is quite incalculable. I believe that a very small insect lays its egg in the Hop during the early part of August; in a short time a pinky white larva appears, which lives by eating the strig (*i. e.*, stem or midrib), and the Hop withers from the point where it has been attacked."

Prevention and Remedies. — As (so far as I am aware) there are no published records, either of the nature or the name of this infestation or of measures to keep it in check, we can at present only rest for guidance on such knowledge as is before us of the habits of the insect. But, so far as we see at present, this maggot (like those of various other kinds of *Cecidomyiæ*), when it is full fed, leaves its feeding place and drops down to the ground, for its winter shelter, there to undergo its changes, and from thence to come up again in the following summer, in perfect state, to lay its eggs in the Hop-cones.

We have clearly made out both that the maggots fall to the ground and that they then bury themselves in the earth, from the following very good observations reported to me on the 26th of September (in reply to some remarks of my own) by Miss E. J. Stevens from Cobham, near Gravesend:—"You are quite right in supposing that the maggots fall from the Hops to the ground. The afternoon I received your letter I spread some black lining under two of the Hop-hills, and the next morning there were hundreds of maggots on it, jumping about. We

brought some home and put them on some earth in a box, and in two hours they had nearly all buried themselves in the earth." . . . "The same parts of our Hop-grounds seem to be most infested with the maggots each year, so it does not seem as if the midges travel far before they lay their eggs."—(E. J. S.)

What is needed is, to destroy the maggots between the time of their going down and that of their development to gnat midges and flight. It may certainly be considered that they lie either at the surface, in rubbish that may shelter them, or very little below it, because the maggots are too little to pierce down deeply with any chance of the minute and weak gnat-fly of soft texture, and with no apparatus for boring, coming up to the surface through a weight of earth. But how to get rid of them is a question for Hop-growers. Most likely dressings of farm manure would do little, if any, good. Caustic dressings thrown on the surface of the soil, or lightly forked into it, not of kinds or in quantity to injure the roots, would very likely be beneficial. Stirring open the soil, or clearing off the surface, as well as could be managed, and throwing it thinly about so as to expose the maggots to winter weather and birds, would probably do some good. Or if a dressing *could* be used, of ashes or dry earth with a little paraffin in it, this, if thrown on the hills at the time when the Gnat-midge might be expected to come up, might very likely indeed do good.

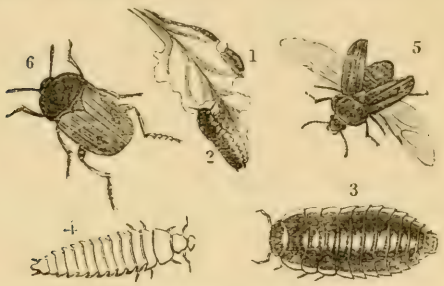
In the Stoke Edith experiments regarding Hop Aphis, we found the above application, in the proportion of a quart of paraffin to one bushel of dry material, did not in the slightest degree injure the Hop-shoots which came up through it, and there was no appearance of Aphis attack on the bines from these hills (though it occurred on those of which the soil had not been thus dressed), until attack came in winged form.

From this we considered the wingless Aphides could not come up through the dressing, and I should not think that the little Cecid gnats would be more capable of penetrating. The time when the mischief is begun must be after the Hop-cone has made much of its growth, because (so far as specimens sent show) the cone is not so much injured by being stunted in growth as by the central stem being tunnelled. We find the grown or moderately grown strig with the tunnels in it.

But, excepting the date when the Gnat-midge appears, there seems to be all information at hand regarding its life-history that is requisite for applying remedial measures, if those most conversant with treatment of the Hop-hills could work out how these should be arranged.

MANGOLDS.

Beet Carrion Beetle. *Silpha opaca*, Linn.



Silpha opaca.

1, 2, young grubs feeding; 3, 4, grubs differing in shape, somewhat magnified; 5, female beetle flying; 6, male beetle, magnified.

The attack of the Beet Carrion Beetle to Mangolds has so rarely been noticed in England, that I believe this is only the second year in which it has been so recorded as having been observed here, although the beetle is very commonly to be found in connexion with small dead animals, whence the second part of its name. It has long been known as occasionally occurring on Mangolds in Ireland, and in 1888 it was found to be severely injuring Mangold plants at three distinct and widely separated localities in England, namely, near Shrewsbury; near Newport, Mon.; and at some farms near Honiton, Devon.

In the past season it was again recorded as present, and again in Devonshire, but only at one locality, namely, Batworthy, Chagford, near Newton Abbot, in the Exmoor district, a good many miles from the previous places of appearance near Honiton.

On the 1st of July, Mr. F. N. Budd, writing from Batworthy, with specimens of the grubs accompanying, noted that these were samples of larvæ which were doing great damage to his Mangold crop, and so far as he could make out were larvæ of the Beet Carrion Beetle (*Silpha opaca*); but, Mr. Budd observed, "I have never seen them before, and presume they are not commonly met with in this country as a Mangold pest."

The grubs were certainly the black, somewhat woodlice-like grubs of the Beet Carrion Beetle, which, though variable in shape, as shown in figures 4 and 5, may be known by the sharp edges of the sides of the segments (succeeding the three first), which altogether give a saw-like appearance to the sides of the grub; the sides of the three first segments are rounded.*

* For descriptions and observations on attack of 1888, see my 12th 'Report on Injurious Insects,' pp. 91—96.

On the 7th of July, Mr. Budd further remarked :—" This particular pest has now pretty well left my Mangolds. A diligent search has resulted in one small larva found alive, and several empty shells, but no pupæ and no perfect insects. I cannot account for their sudden disappearance from my crop, unless it be that the insect has reached its perfect stage and gone away. I fancy I only observed the larvæ at a comparatively late period of their existence, when the majority of them were approaching the chrysalis stage, but yet the specimens I sent you were, as you observed, by no means full grown, and the larvæ were at the date of my letter plentiful."—F. N. B.

It seems to me that, if another opportunity should occur, it would be well worth while to watch what may happen at this stage of life among the grubs, that is to say, whether a portion of them may not feed on their brethren. In regular course of things the grubs have been recorded as going down into the ground when full fed, which may be about the end of June. There they form cells, about three or four inches beneath the surface, in which they change to the chrysalis or pupal state, and from these the brownish black, rather downy beetles may be expected to appear in about three weeks.

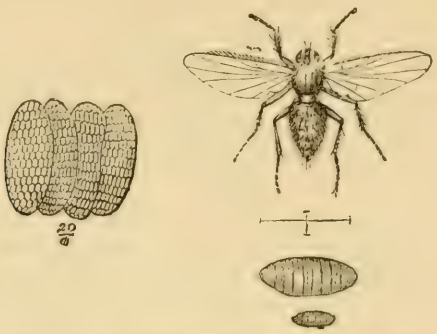
But in the course of my observations of the Beet Carrion maggots in 1888, I found, in the case of two consignments sent me, that some of the grubs had apparently been feeding on the others, as there were broken remains of the skin of other *Silpha* larvæ in the box. These broken pieces would correspond with Mr. Budd's description of " empty shells " ; and looking at the fact of his grubs being by no means full grown, therefore unlikely to go down into the ground at the time, it certainly seems open to doubt whether they did not exercise their normal carnivorous propensities on each other. It would at least be worth while noticing, as occasion might allow, whether this is the case.

As the ordinary details of this attack and means of prevention and remedy have been given in my Report already quoted, also as it is very rarely of any practical importance in this country, I do not repeat them again here, but just mention the attack to keep up record of what so far as appears is, in this country, a rare crop infestation.

Mangold-leaf or **Beet Fly.** *Anthomyia* (*Chortophila*) *betæ*, Curtis.

Mangold-leaf maggot was unusually prevalent during the past season. This attack is usually reported to a moderate extent, or at least as being present at a few localities ; but last year (1891), so far as I can judge by reports sent to myself, it was far more prevalent than in any year since the severe attack of 1880. In that year it was

destructive in various localities, and especially in Westmoreland and Cumberland, "where of 1624 acres of Mangolds grown in those counties, it was reported that all were infested."



ANTHOMYIA BETÆ.

A. betæ (female), mag.; line showing spread of wings, nat. size; pupa, nat. size and magnified. Eggs (after Farsky), mag.

In the past season it was reported in the more southerly and westerly parts of England. The worst attack was in Devonshire, where the infestation was severe and widespread in the northern districts; it was also reported from near Camelford in the north of Cornwall, and from various localities, either single farms or districts, respectively in Warwickshire, Oxon, Notts, Northamptonshire; from Knebworth, Herts; Royston on the border of Cambridgeshire and Herts; Hawkhurst on the border of Kent and Sussex; and likewise in Hants, and also at Treffgarne, in Pembrokeshire, and from farms near Abergele, in Denbighshire. The first specimens were sent about the 22nd of June, and enquiry continued at intervals from that time up to the beginning of September, thus including observation of the whole summer's attack, from the first outbreak, more or less ruinous, on the young plants, to the commonly less hurtful blisterings in the autumn leafage.

No new points have been brought forward in the history of the attack itself, which is well known, but for practical purposes it cannot be too well known and clearly laid down that *the* great characteristic of this attack is the leafage being first marked with blisters where the maggots feeding within have separated the upper from the under side of the leaf; and afterwards, when the attack has gone on for a while, these portions turning, as they die, to a brown colour. Thus, where attack has been going on badly for a time, a great part of the leafage may very likely look brown and scorched.

Where the attack is not recognised, the injured leafage is very likely to be at first considered merely "scalded," and thus valuable

time is lost in applying some remedy which would in all probability have pushed on the crop through the time of infestation.

The method of attack is for the fly to lay her white eggs (see figure) (which look very like common "fly-blows") on the under side of the leaves. The maggots from these bore into the leaves, and there feed for about a month. These maggots are little, legless, cylindrical grubs, somewhat tapering to the head end, and whitish in colour, or sometimes greenish from the coloured juice on which they live showing through the transparent skin. When full fed they turn to chestnut-brown puparia, of the size and shape figured at p. 60 (nat. size and magnified). This may be either in the leafage on which they have been feeding, or in the ground beneath them, and from these chrysalis cases the two-winged flies come out *in summer* in about a fortnight or less.

These flies may be generally described as of an ashy grey colour, with some darker markings and with black bristly hairs, and are said to appear as early as from March to May. These lay the eggs of the first attack, and broods may continue through summer and autumn, but two broods may be (under common circumstances) quite expected. The last brood of the year may pass the winter either in chrysalis state or sometimes as the perfect insect.

The following observations are given much in order of the date in which they were received. Amongst points of interest, one is the great number of eggs which may be found on one leaf, and also how soon the maggots hatch. Also the very valuable observations given in detail by Mr. Haydon as to any treatment, or condition of soil, or of situation, which is calculated to push on good growth, being beneficial in lessening effect of the infestation, or carrying the plant over attack (see p. 63). The observation also of Mr. Coutts (p. 64), "They came first just after being singled," is well worth notice, as drawing attention to the time when presence of attack and the need of remedial measures may especially need attention.

Amongst badly attacked specimens sent me, on June 22nd, by Mr. John Hilder (bailiff to Mr. P. Beresford Hope, of Bedgebury Park, Flimwell, near Hawkhurst), I found about one hundred and forty-six eggs of the Mangold Fly, possibly more, on the under side of one Mangold leaf, only a little more than three inches and a quarter in the length of the blade. Some of the leaves were already severely blistered. Mr. Hilder noted how very quickly the maggots hatched from the deposited eggs.

On the 24th of June, Mr. C. E. Bruce Foy, writing from Mollington, near Banbury, with badly attacked specimens accompanying, mentioned that his Mangold plants were infested this year with the grub in the leaves, of which he sent samples, and that several farmers in the

neighbourhood, as well as in the Rugby district, had their Mangolds similarly affected.

This proved to be a decidedly bad attack of Mangold-leaf maggot ; some were just turning to chrysalis state in the blistered leaves, or amongst them, as the case might be, and many were straying about amongst the leaves sent. Most of these were nearly or quite full grown.

With regard to treatment of the field, Mr. Bruce Foy observed :— "I mucked the field in the autumn, and drilled the Mangold seed on April 25th ; they have been flat hoed and are now singled out ; but I notice each day the leaves are becoming discoloured, and in some cases I have found as many as twelve grubs of various sizes and ages in one leaf, and you will find plenty of them in the sample I send. I have to-day sown soot between the rows of one acre, and on another acre a mixture of nitrate of soda and salt, in the hopes of pushing on the plants."

A few days later (on the 29th of June), Mr. Richard Ramsden, writing from Chadwick Manor, Knowle, Warwickshire, observed :— "I send you herewith enclosed a sample of a Mangold leaf with attacking insect or insects. I do not remember ever having seen such an attack before, and it has covered the whole field of two or three acres, *scarcely a plant escaping*." In this instance I had not enough sample to enable me absolutely to make sure by examination of the nature of the attack, but it was not open to doubt that it was of Mangold-leaf Maggot.

In a further communication, Mr. Richard Ramsden added the following remark as to previous non-observation of the attack, which would probably explain also the previous non-observation of it in other localities where it was reported as now being first seen :—" Carefully thinking over the matter, I expect I have seen it before, but when the Mangold was in a more advanced stage of development, and possibly then I attributed it to the leaf being scalded by sun. This attack is very general ; more plants are evidently struck by it than have escaped, and it is in two fields of mine."

About the same date as the above, namely, the 29th of June, Mr. John E. Thurnall, writing from Royston (on the border of Cambridgeshire and Herts), sent specimens of the Mangold Maggot, with the following clear description of the attack given in few words :—" It appears that some fly deposits its eggs on the back of the leaf, and that a maggot then appears between the tissues of the leaves, and causes the leaves to fail and ultimately destroys the plant." Mr. Thurnall further added that he had been that day (June 29th) over a Mangold field on a farm near Knebworth (Herts), and every plant seemed to be affected.

On the 30th of June the first notes were sent me of what was shortly after reported as a widespread and severe attack of this Mangold infestation in North Devon. Mr. R. W. Haydon, writing from Great Coombshead, North Molton, Devon, reported:—"I am sending you by this post some Mangold leaves attacked by the Mangold Fly. You will find the maggot of this fly beneath the epiderms of the leaves. I have taken the leaves from a field of Mangolds on my father's farm. A large number of farmers in North Devon are complaining that the fly has done considerable damage to the young Mangold plants. I have only inspected the fields of Mangolds on my father's farm, and although they are certainly damaged, still I think the crop will not suffer to any great extent."

On the following day specimens of infested Mangold leaves, with the maggot fully or nearly fully grown, were forwarded to me from Hele, S. Molton, Devon, by Mr. Christian Gould, with the note that they were samples of Mangold leaves from his crop of ten acres, which the maggots were destroying, and which would be quite a failure unless something could be done to exterminate them.

Other information was sent about the same date, referring to this same attack (well described as of the Mangold leaves containing maggots in blisters like those caused by the Celery fly) being severe in North Devon.

On the 1st of July also observations were made of the same attack occurring near Camelford, on the north of Cornwall. The attack about this time became so general in the district, that it was brought forward in various of the western papers (in some degree referring to my own remarks) by Mr. W. J. Harris, of Halwill Manor, Beaworthy, North Devon; and later on I was favoured by the following further notes from Mr. R. W. Haydon, of Great Coombshead, North Molton, Devon, in continuation of those previously sent on the 30th of June. These, it will be seen, are of serviceable interest, as they note a general opinion of the farmers as to nitrate of soda being beneficial in carrying the infested plants over attack; also they mention the benefit of previous good cultivation, and of various special dressings, and that crops in situations favourable to growth suffered less than others, and likewise some amount of estimate of loss is given.

Mr. Haydon wrote as follows:—"I have made numerous enquiries about the attack, and have visited many farms in various parts. The early-sown Mangolds have generally suffered more than the later ones. Mangolds sown on the flat have suffered *less* than those sown in ridges. All the farmers corroborate what you say in your pamphlet about the effect of nitrate of soda. The attack was pretty well universal, and, as might be expected, those crops which were existing under the most perfect conditions of growth best survived the attack. Where the land

was well cultivated and made firm, and had received sufficient dressings of nitrogenous manures, in addition to salt and superphosphate, the crop best overcame the attack.

The *late, cold,* and somewhat *dry* spring checked the growth of the crop, especially those on ridges. I have noticed that those crops in favoured situations, as regards climate, have suffered least of all. In Devonshire, where the hedges are very high,—higher than those of any other county,—that portion of the field which was sheltered by these hedges grew away from the attack better than the rest of the field. Mangolds on high-lying light land have suffered most. I have seen a number of farmers who estimate that their crop will be reduced one-half by the attack. This means a loss of from £5 to £10 per acre. In a few cases the crop has been totally ruined.

On the 21st of July, also, I had information from Prof. Douglas Gilchrist (of the Bangor University College, N. Wales). Writing from Hafodunos, Abergele, Denbighshire, of the presence of the Mangold Maggot in that district, he mentioned that the attack had considerably delayed the crop, which was not one grown extensively in the district; and also that here, as in some other instances, the infestation was reported as not having been seen before in the district. This, however, is probably from the blisters on the leafage being ascribed to scalding or unfavourable weather influence of some kind or other, and consequently no special examination made which would have shown the maggots within.

Other communications regarding presence of attack were sent, which it is not worth while to enter on in detail; but towards the latter part of August information was continued, showing the presence of the late summer attack.

On August 20th, Mr. C. Coutts, writing from the New Inn Farm, Widmerpool, Nottingham, observed:—"We are the second time this season troubled with maggots in the Mangold leaves. They came first just after being singled, and then in ten days or so left. They have come again, but worse than the first time. The leaves are badly shrivelled up." . . . . "There are five fields badly damaged, and we have two fields that have not been touched as yet, but look healthy and doing well. I find the fields that are manured with artificial alone are the worst."

On the previous day (August 19th) specimens were sent me by Major F. Willan, from Thornhill Park, Bitterne, Hants, with the following notes, which show what great injury was then being caused by the infestation:—"Herewith I send some specimens of Mangold leaves. The crop, in a ten-acre field, has been much infested with some grub, which establishes itself between the inner and outer parts of the leaf and eats its way along. Several may be seen in the leaves sent."

. . . . "My own crop *has* been in a fearful state, but the late heavy rains have improved its condition a great deal. Some other farmers near here are still worse afflicted. This disease was first noticed about three weeks ago.

On the 27th Capt. G. H. Ringrove forwarded from the Estate Office, Whittlebury, Towcester, specimens of Mangold leaves infested by this same maggot, and which, he observed, "appeared to be destroying the crop. We had a splendid show of fifteen acres, but now all the leaves are fast disappearing, and apparently from the ravages of this pest."

The latest communication which I received as to the presence of the maggot was sent me on the 1st of September, from Scolton, Treffgarne (Pembrokeshire), by Capt. J. Higgon. Blistered leaves and Mangold-leaf maggot were sent accompanying. Capt. Higgon noted that the attack "first appeared under the leaves like a fly-blow, soon grew into the maggot stage, and then destroyed every leaf. They are now dying off, but the Mangolds have been completely checked in growth of course.

Prevention and Remedies. — It will be seen from the foregoing observations, especially those of Mr. Haydon, that this year's notes quite confirm the reports previously given, of the importance of all treatment and measures of cultivation in preparing ground for Mangolds which are suited for pushing on strong and healthy growth, and thus, though not preventing attack, at least lessening the bad effects. Also, amongst different dressings which are serviceable to keep up the strength of the plant, by helping to replace the destroyed leafage as soon as possible when attack is present, nitrate of soda is again mentioned as one found serviceable. These points have been given in detail before; therefore it is not worth while to repeat them, more particularly as they are such matters of treatment as are thoroughly well known to all Mangold growers.

ORCHARD CATERPILLARS.

Winter Moth, Evesham Moth, *Cheimatobia brumata*, Linn.; and various other species.

CHEIMATOBIA BRUMATA.
Winter Moth. Winged male and wingless females.

The subject of orchard moth caterpillars and prevention of their ravages has now been entered on in these Reports so fully, and for so many successive years, that it appears unnecessary to offer further observations again this year on the points which have been already so thoroughly gone into. We have before us, from careful and skilled observation, not only the full life-histories of the most injurious kinds, but special points in their habits showing us (particularly in the case of the Winter Moth) how they can evade (that is, some proportion of them can evade) the barrier of grease-banding set before the wingless moths, and how their various ways of neutralising the use of these barriers, by laying eggs beneath them, or bridging them over for convenience of later comers, has been met. The more extended time of appearance in autumn, and the existence of winter and spring appearances, have been much more fully made out, and with the knowledge of the greater need for preventive and remedial measures we have also detailed record of the enormous advance that has been made in these.

Where the measures of former days, as, for instance, tarring the trees, has been proved to be inefficient and dangerous to the growths, we have improved on it step by step till we have now full details of how the grease-banding, which has taken its place, not only can be, but *is*, constantly carried out so as to be of great service. Also—and which is of the highest importance in the present considerations—we can lay our hands now on precise details of washes or sprayings of various kinds, which may be brought to *bear at once* on the ravaging hordes of caterpillars, if, either from their parents having evaded preventive measures, or having, in the case of various kinds, come in natural course on the wing, these their progeny suddenly appear in myriads on the growing leafage.

This advance has been the work of years, and the result of observations of many orchard growers; but in especial it appears to me that we are indebted for much well-authenticated information to the work of the Experimental Committee of the Evesham Fruit Growers. Under their care experiments were carried on, according to definite rule, and the results examined and reported on at their successive meetings on the large grounds of the different members where they had been carried out, and measures recommended accordingly. Thus we have well-skilled and thoroughly practical opinions to go on, and the Report of their operations during 1890, published early in the present year, is well worth perusal.*

In my own 12th, 13th, and 14th Annual Reports the histories of orchard moths and means for their prevention are entered on at great length, with information from many observers, especially bearing, in the 13th Report, on details of sticky banding, and various kinds of washes; and, in the 14th, on the great advance made by adoption of use of Paris-green spraying, together with the requisite directions for its safe and successful application.†

Under these circumstances I have endeavoured, in the following paper, to take up (with some requisite exception to save trouble in reference) only points which have been little brought forward; and first amongst these are notes showing that the condition of the moths and their subsequent egg-laying did not appear to have been influenced by the winter cold.

The observations of orchard insects of the past season were commenced by the following notes sent me, on Jan. 30th, by Mr. Thomas E. Doeg, of Evesham, which are of much interest, both as showing the capability of the orchard moths for appearing so late in the season, and also that they were in no way injured or deterred from appearance on the first mild evening by the very severe cold term which had preceded the date of the observations.

It will be seen that the two kinds of moths noticed as being taken on trunks of Apples and Plums are the Winter Moth, *C. brumata*, and the Mottled Umber Moth, *H. defoliaria*. The moth named as being found in great numbers on the hedgerow, namely, *Hybernia rupicapraria*, is the kind popularly known as the "Early Moth," of which the eggs are said to be laid in February on Whitethorn, Blackthorn,

* 'Report of the Evesham Fruit Pests Committee,' pp. 55, price 6d. Printed by W. and H. Smith, Bridge Street, Evesham.

† 'Reports of Injurious Insects,' by E. A. Ormerod, price 1s. 6d. each. Published by Messrs. Simpkin & Co., Stationers' Hall Court, London, E.C. I have also issued a short 8vo pamphlet of eight pages, with full directions for use of Paris-green, which I should be happy to forward gratuitously to any applicant desiring it for practical service.

&c.; so that this species was appearing about, or a little before, the customary time. The "Satellite" Moth, the *Scopelosoma satellitia*, of which it is mentioned that a few specimens were observed, hybernates in the moth condition, and is stated to come out in the spring, and lay its eggs in March; therefore, this kind also could not be considered to be suffering from the preceding cold. This moth is larger than the previously named species, and in shape, size, and general colouring, not at all unlike the well-known Turnip Moth, to which it is nearly allied. The chief difference is that the fore wings of the "Satellite" are reddish brown in the ground colour (instead of being pale grey-brown or dark umber-brown), and the hinder wings are smoky instead of whitish. This species is one which, if possible, should always be spared, because the caterpillars (at least, until nearly attaining their full size), are recorded as being carnivorous, and feeding on the caterpillars of other moths; amongst the kinds preyed on, young caterpillars of the Winter Moth are especially mentioned.

The "Satellite" caterpillar is described as being of a rich velvety brown colour, with three paler lines placed lengthwise on the second segment, and occasionally observable as faint stripes continued the whole length of the body. There are also about four white spots on each side of the body, but these may be variable in number.

I have not had the opportunity of studying the above-named insect myself in living state, and therefore acknowledge the above notes, as taken from the very good description given in Edward Newman's 'British Moths,' at pp. 371, 372.

With regard to the date of appearance of the moths, in reply to some observations or inquiries sent to Mr. Doeg by Mr. Gibbon, of Seaford Grange, Pershore, Chairman of the Evesham Fruit Growers' Experimental Committee, Mr. Doeg wrote, on Jan. 30th as follows:—

"I went to Seaford Grange last night. It was a mild dark evening, with a misty sort of drizzle; just the sort of night that yields a grand harvest of insects to the 'sugarer' when it occurs in July or August; and, as we anticipated, there were plenty of moths about. We took female *brumata* and *defoliaria* on the trunks of *Apples* and *Plums*, some of the latter trees being *amongst the Gooseberries*, where we noticed the 'borers' at work last spring. The Plum trees themselves were not much attacked last season, for Mr. Gibbon is an ardent believer in the *grease-band*. The males were not much on the wing, and my experience is that the Geometræ, as a group, fly *principally* just at *dusk;* so one would not expect to find many flying between 9 and 10 o'clock on a night in January. In support of the probability that many were about earlier in the evening, I may mention that a large number of *living* and *freshly-caught* males of the 'Mottled

Umber' were sticking in the grease-bands on the *Apple* trees, where this species seemed most prevalent. We found one hedgerow swarming

HYBERNIA RUPICAPRARIA.

with males of *H. rupicapraria*, which we all at first sight took for *brumata;* but I secured a few in the cyanide-bottle, and, on making an examination of them with a better light than the lantern gave, I find they are the former species."—(T. D.).

An examination of the figures of the two species of moths given above will show the great similarity of appearance on general inspection. They are much about the same size, and the females in either case have abortive wings, which, though useless for flying, are still large enough to be clearly noticeable. The male *rupicapraria*, or "Early Moth," is distinguishable, in a general way, by the fore wings being darker, and the hind wings lighter, than those of *brumata*, or Winter Moth.

A little later—on February 20th—Mr. J. Wright (of the 'Journal of Horticulture') wrote me regarding *non*-effect of the long-continued frost on vitality of the eggs experimented on:—"We have recently passed through the longest frost that has been experienced in the South of England for more than 100 years; yet trees with eggs on them placed in heat at Glewstone Court a week or two ago speedily produced a full crop of young caterpillars."—(J. W.).

One of the first notes of appearance of the caterpillar-pests was sent me, on March 26th, by Mr. C. Lee Campbell, of Glewstone Court, Ross, Herefordshire:—"Just a line to say that I commenced my Paris-green spraying yesterday. To-day my gardener reports that he has found three caterpillars at work; so it is time to sound an alarm."

On April 16th, Mr. Hiam, writing from Astwood Bank, near Redditch, noted that "the eggs of the Winter Moth (*Cheimatobia*) are also just coming to hatch on a few small trees which I did not grease-band. Trees properly banded I cannot find an egg on." And on the 25th of the same month, Mr. Henry Martin, Fruit-grower, Bredon, Tewkesbury, wrote me, "We have the Winter Moth hatching out in

this district in very large numbers"; and he expressed a hope that by the measures recommended they would be able to keep the pest down.

With regard—more especially—to the experiments, or rather (we may now say) the successful work, that is being carried on in destruction of orchard caterpillars by spraying with Paris-green, as it is unnecessary to take up space again with a mass of reports on the subject, I merely give a few observations this year from well-known authorities to show that the application is still well-proved to be satisfactory and serviceable, *where the directions issued are followed;* and also that the application is being extended usefully to spraying fruit-bushes.

The following note, which was sent me, on July 14th, by Mr. C. D. Wise, from the Toddington Fruit-grounds, Winchcombe, Glos., where, it will be remembered, Paris-green spraying was carried on largely in the previous season, it will be observed speaks markedly not only of the good prospect of Plums, but also of the *particularly healthy* state of their foliage, which is a most important consideration. Mr. Wise wrote to me as follows:—"We have a wonderful prospect of Plums this season; our trees are looking particularly healthy in their foliage. What they would have been if we had not taken all the trouble we did to get rid of insect-pests, it would be impossible to say!"

Later on, Mr. Wise sent me the following note, reporting the enormously lessened amount of appearance of Winter Moths this autumn:—"We commenced grease-banding this year on the 5th October, and we have done just the same as last year, using the grease-proof paper and grease free from pungent oils. Putting on the paper and grease costs us about 6d. per 100 trees labour only. We have seen hardly any of the female moths; in fact, I have not heard of more than six throughout our plantations. This looks as if we had got the upper hand of them at last."

In these notes we have report of the joint good effect of grease-banding at time of moth ascent, and of Paris-green spraying at caterpillar time. In the following observations with which I was favoured by Mr. C. Lee Campbell, of Glewstone Court, near Ross (at my special request, as I was aware he had devoted most careful consideration to the subject), no grease-banding had been used, the successful results were from use of Paris-green. But in each case the point is markedly brought forward, which is not enough considered generally, namely, *that where preventive or remedial measures are properly carried out, we have not only benefit at the time, but the hordes of attackers, being thus enormously lessened, we have so much less to do in the future with fighting their progeny.* Mr. Lee Campbell observed:—

"I have nothing to retract as regards 'Paris-green,' and see no reason to change my views as to the proportion to be used, *viz.*, 1 oz.

to 20 gals. of water. That amount does not injure my Plum foliage, while it kills the caterpillars; and, of course, there is no reason why the same dose should spare the caterpillars on any other foliage. What, then, is the use of employing anything stronger?* The essential is that the liquid be syringed carefully in dull weather, and be constantly and thoroughly stirred *all the time of using*. Very few people yet seem to take any trouble to know whether the eggs are there at all; whereas, if they look carefully, they would find that the hatching-out period extends over three months, which was my reason for syringing ten times over three years ago. The leaves at first, during my apprenticeship, were much burned, but the trees did not seem to suffer; and the next year I had to syringe only three times. This year I have only syringed once, and I finished off the caterpillars by having the trees sharply shaken, and the fowls ate all the pests. My whole field has been a perfect sight this year, as to the Apple trees, and I have had a very satisfactory crop (which, however, was very materially lessened, especially as to Plums and Pears, by the frost of the 16th May). The promise of fruit—in the shape of buds—for next year is splendid.

"As to the danger in using Paris-green, for all practical purposes it is non-existent. Of course, if a deadly poison is handled as one would basic slag, no doubt there is danger; but as I have used it here more intensely probably than anyone else, I am in a position to affirm that only stupidity on the part of the operator can cause any bad results. I should like to be able to report the entire disappearance of the Winter Moth, but, as a matter of fact, he put in his appearance about the same time as last year (Oct. 8th), and my gardener reports that he swarms in the lanes. Mr. Watkins, of Withington, says the same, so that we shall now be very vigilant. So far we have found no eggs and very few moths in my field.

"There is what seems to me an ignorant prejudice against grease-banding. I do not practise it simply because my trees are pyramids, but I am firmly convinced that in spite of some curious anomalies it is the safest thing to do for standing trees; only, the grease must not touch the bark."

The above observation of Mr. Lee Campbell as to absence of eggs and moths on his own land, and prevalence in the lanes, confirms the evidence of benefit from local destruction of the pests. The male

* This, I think, is a very important consideration. The American and Canadian economic entomologists have repeatedly written to me on the strangeness of the fact that the Plum leafage here should bear such a much stronger application than with them, where, in the words of one correspondent, "it would scorch every leaf off the tree." Therefore, I certainly think that in giving the stronger quantity of 1 oz. of Paris-green to 10 gallons of water, although we have good record of it answering, we are working too near what may prove a danger.

Winter Moths, being winged, may, of course, betake themselves anywhere; but the females, which cannot fly, must, so far as they depend on their sole exertions, walk up the trees, beneath which they have lived in chrysalis-state, and on which they feed as caterpillars; and their absence is a proof of the good which has been done by treatment.—Ed.

The following notes which refer to success in clearing caterpillars from Black Currant leafage, by means of application of Paris-green spray with the "Eclair" knapsack-pump, were sent me, on May 18th, by Mr. John Speir, of Newton Farm, Newton, near Glasgow. Mr. Speir noted that the first of the caterpillars were seen on the 10th, and the next two days, being particularly warm, they appeared in thousands; and that he had "had the 'Eclair' going for two days previously, but, as showers were coming on occasionally, the Paris-green appeared to get washed off, and to do no good. Also, as new leaves were unfolding almost daily, there were always some clean leaves to feed on."

Consequently, however, on this great appearance of caterpillars, Mr. Speir had energetic measures taken; and I give his report *verbatim* as a record of the success of the application on fruit-bushes, and also as the experience of one of our very leading fruit-growers:—

"From Monday morning I kept spraying from 5 a.m. to 8 p.m., using at first 1 lb. to 200 gallons, and latterly 1 lb. to 150 gallons. At first the spraying appeared to have no very great effect on the caterpillars, but about the 14th I saw they were decreasing, and from then till now (18th) they have died off wonderfully. On Monday it was difficult to get a sprig without caterpillars, while to-day few are to be had with them. All my bushes have been gone over once, some twice, and a few three times, and I am going to go on as long as any remain. In only a very few cases have any of the leaves been scorched, and then apparently from the liquid at the bottom of the 'Eclair.' I am also doing the Apple trees, and, although I see I am quite unable to prevent damage to the foliage to a little extent this year, I expect I will be able to very much reduce it by another one, as an enormous crop of chrysalids must be done away with."

On Tuesday, May 12th, during the visit of the Fruit Experimental Committee at Toddington, Mr. Gibbon (Chairman) reported that "he had been spraying his Gooseberries. He observed the sawfly on the Gooseberry bushes, and they sprayed them with Paris-green, and they could not see any left now. They used 1 oz. of Paris-green paste to 12 gallons of water. His trees were looking beautifully healthy."*

* The above is quoted from the 'Evesham Standard' for May 16th, giving a detailed report of the meeting, as I cannot at this minute lay my hands on a report by Mr. Gibbon on this point amongst his other observations sent me.—E. A. O.

There are difficulties in the way of any new application, but we have plenty of evidence, given in long detail, with the well-known names of the experimenters attached, of the success with which the application can be used; and we have any amount of evidence that there is nothing else which has been found to answer in this country, save this mixture, to make a thorough clearance, at one or two sweeps of spraying, of the *hordes of all the various kinds of caterpillars* which so long have devastated our orchards early in the year at their pleasure. London-purple may very likely be found in time to answer as well, or even better, but as yet we have not such full record of experiment; and this, like Paris-green, is a poison.

Attention to directions necessary for success.—The use of Paris-green has been spreading more widely, and, so far as I can judge from the reports sent me, the spraying is successful where the directions issued are followed. But the difficulty is immense in getting this matter attended to, and consequently trouble arises.

Two years ago the use of Paris-green spraying was almost or quite unknown in England, but since then our own experience has confirmed that of many years of American application in showing the success, WHERE USED ACCORDING TO DIRECTIONS; and the following list of disasters and their causes, arising simply from non-attention to directions, which has been placed in my hands by a well-known fruit-grower, is eminently instructive. I give it throughout almost in his own words, and append to each paragraph of it extracts from my own pamphlet on the use of Paris-green, to show how in every case attention to the "Directions" quoted from it would have saved the disasters.

Difficulties noticed. 1*st.* "*I find that growers, when confronted with a strong attack of the caterpillar, get impatient to destroy them, and use the Paris-green in a stronger proportion than what is recommended.*"

DIRECTIONS.—"The amount of Paris-green found serviceable by the Evesham Fruit Pests Committee, and which they decided they could recommend, was:—Paris-green paste in the proportion of 1 oz. to 8 or 10 gallons of water for Plums;* and 1 oz. to 20 gallons of water for Apples. Apple leafage was found to be more tender than that of Plums. Pear leafage should be treated like that of Apple.

"For Currants the strength found safe was the same as for Plums —1 oz. of 'green' to 10 gallons of water; but as the foliage grew stronger, 1 oz. to 8 gallons of water was found not too strong. Neither of these strengths of mixture damaged the leafage, but they killed the caterpillar.

"Capt. Corbett, the Superintendent of the Toddington Fruit

* See note regarding safe strength for Plums at p. 71.

Grounds, writing to me on the 3rd of July, 1890, and mentioning his satisfaction with the results of spraying, also noted, 'The proportions I fixed upon after the first trials, *viz.*, 1 oz. to 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples, must not be exceeded.'

"'Insist upon the mixture not being made too strong; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1 lb. to 120 gallons.'—(J. F.). Advice sent by the Entomologist of the Dominion of Canada."

Difficulty 2*nd.* "*I find that even when the Paris-green is used in the proportion of* 1 *oz. to* 10 *gallons of water, unless the operator is judicious and careful, the foliage of the trees will get injured. This would arise from the particles of the Paris-green settling at the bottom of the vessel during the time it is being applied, so that the effect in such case would be that one portion of the solution is too weak to accomplish any object, and the portion at the bottom of the vessel would be disproportionately strong and dangerous. So that care should be used in putting solution in general commotion every few minutes, so as to avoid the Paris-green settling.*"

DIRECTIONS.—"In application of Paris-green sprayings, it must always be borne in mind that, whatever kind of engine or spraying machine is used, the mixture must be kept an even strength throughout, and no sediment allowed to form at the bottom, or damage to the leafage is sure to happen.

"On these points Mr. Fletcher, the Dominion Entomologist of Canada, wrote to me as follows, and also enforcing care as to over-application :—

"'*Paris-green.*—You are quite safe in recommending this; but insist upon these two things, *viz.*, 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated; and as the barrel is frequently re-filled the residue will keep accumulating, until it will be too strong as the mixture reaches the bottom.'"

Difficulty 3*rd.* "*Another danger arises from the operator,* 1*stly, putting on the solution too copiously. Great care should be used in securing the best sprayer; the 'Eclair' I have found the best.* 2*ndly, to be careful that the foliage of the trees is only bedewed or well-misted. If a quart of the fluid is used in suffusing a tree when a pint would be adequate to destroy caterpillar-life, your excessive quantity of fluid used would be equivalent to the using of an extra quantity of Paris-green.*"

DIRECTIONS.—"With regard to method of application of the spray. This should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine

dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

"It should on no account whatever be thrown so as to 'swill' or 'souse' the trees, and run off the leaves in drops or streams; this is bad practice in every way. It uses a great deal more of the chemical than is needed; the leaves get little but pure water at their highest part, and much too strong application where the fluid has settled at the tips; and also a drip is caused on to the ground beneath, which may render the grass temporarily poisonous,

"Also, spraying should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless, of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it."

The above difficulties, it will be seen, are what are most carefully pointed out in the "Directions," as the details regarding which care *must* be taken to ensure success, and the requisite points to the end are most fully laid down in my own short pamphlet on the application of Paris-green, from which I have given the extracts of directions. I am only happy to send to any applicant who wishes for it for practical orchard or fruit-growing purposes, or it is procurable per dozen or hundred from my publishers.*

To the above extracts I add the following with regard to the care which, with this arsenite of copper, as well as with all other poisonous preparations applied in farm or orchard service, must be exercised in its use:—

DIRECTIONS.—"The cautions to be observed in the use of Paris-green are:—The bags should be labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful green colour of the powder.

"Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it; *and stock and other animals should never be allowed to pasture or feed under trees that are*

* 'Paris-green or Emerald-green: its uses, and methods for its application as a means of destruction of Orchard Moth Caterpillars.' Demy 8vo. Price 1s. 6d. per doz.; 8s. 6d. per 100. Published by Messrs. Simpkin & Co., Stationers' Hall Court, London, E.C.

being, or have recently been, sprayed, for fear of injury from feeding on grass on which there may have been drip. We give no opening for possibility of mischief occurring from this cause where our advice is followed; but (having noted this duly) there is no harm in mentioning here that where the fine spraying is properly carried on, it is at least open to doubt whether any risk in the above way is incurred."

After mentioning the troubles above noted under the heads of Difficulties 1, 2, and 3, my correspondent further noted an experience of damage to some trees of his own in a case where he had himself carefully arranged the mixture to be of the right strength, but, being called away by business, had left the application to his man. The results showed that the injury arose from the mixture having been applied too freely; and in other instances from the settling of the Paris-green at the bottom of the vessel. Nevertheless, my correspondent closed his report with the following remark, and certainly he is eminently qualified in all ways to offer a trustworthy opinion :— "Amidst all these discouragements, I am still regarding the Paris-green as being ultimately the most efficient remedy."

With regard to different kinds of spraying machines, instead of there being now the difficulties that there were at the beginning of our work, in procuring some useful form, so many kinds are now adapted to various requirements that purchasers may select accordingly. But amongst these, for use on fruit bushes, or on low trees, the kind which is named to me as the most approved, is the Eclair knapsack sprayer. This is a can which may be carried on a man's back, and by means of a hose the spray may be delivered to a height of about fifteen feet.* One great *recommendation* of this spraying machine is that with it the bearer can pass to and fro amongst bushes or low trees, where no wheeled machine is applicable. The *drawback* is that without some care (as the Paris-green settles at the bottom of the can) it is liable to accumulate there, and consequently the sprayings from the lowest part of the mixture be so very much too strong that great injury may be caused to the leafage. This should be looked to at each successive filling, and the sediment, if more than just a trifling amount, emptied out. Otherwise the spraying mixture will be by just this amount stronger than it ought to be. Also, if the Paris-green mixture has stood for a while in this upright form of can, it should be well stirred up before continuing spraying.

Another kind of sprayer which was found very serviceable last year was an ordinary garden engine, with the form of sprayer known as "Stott's nozzle" fitted to it by a piece of hose and a tap union. A

* This Eclair knapsack sprayer is procurable from Messrs. Charles Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C., price 35s., packed and delivered at any railway station.

water-barrel on two wheels, something of the nature of that known as the Farringdon Hop and Plant-washer, was found to answer excellently. A fine spray could be thrown by these means to a height of forty feet, and expense saved of buying new apparatus, which very likely would not have answered nearly so well.

Other kinds of apparatus suited to the purpose, on a more elaborate and expensive scale, will be found named in implement-makers' catalogues.

Different methods of action of insecticides.—Amongst the very large number of letters which were sent me in the past season regarding the use of Paris-green, such a large proportion were with reference to its possible serviceableness in killing Green-fly or Aphides, that a few words may be of service as to the method of action of insecticides. Many kinds of insects, or of insects in their early stages, such, for instance, as the caterpillars of moths or of sawflies, or beetles and their grubs, feed by biting and swallowing the leafage or shoots, or whatever portion of the plant they may attack.

For all these kinds of infestations the applications of Paris-green, London-purple, or any other dressings which are poisonous to insect-life, but which can be used without damage to the leafage, or to the user, will be found effectual if they are so applied that the caterpillar or beetle *cannot consume its food without consuming the poison adhering to it at the same time.*

But with such kinds of insects (Aphides or Plant-lice, for instance) as feed by piercing into the substance of their food-plants with their mouth-suckers, and *merely drawing up the juices from beneath the surface* instead of biting and swallowing the surface, together with what may be on it, the case is different. It may so happen that they or some of them may be killed by a mere superficial poisonous dressing (as of Paris-green, for instance) on their food, but it is by no means certain. The sucker goes down into the juices below the surface, and, excepting where the poison in some way or other may go down also to where the food is being pumped up from, the insect is not likely to be injured by poisoning. We need for these sucking insects something that will kill by contact, which Paris-green does not do. Therefore (as we all know) soft-soap washes, which are especially injurious by adhering to the insects and choking their breathing-pores, are the best foundation for washes to destroy Aphides, with additions of quassia, paraffin, tobacco, or anything else, according to the views of each grower, which may make the wash most deterrent.

Working on the principle of arranging a *composition* of wash which would act by poisoning or choking respectively the different kinds of insects on which it was brought to bear (in mixed attacks), or possibly acting in both ways at once, a consideration arose early in the past

season as to how far it might be serviceable and practicable to use Paris-green and soft-soap together. *This matter of soft-soap and Paris-green* mixture was a subject of great importance, and I was not able myself to offer any trustworthy opinion as to chemical changes which might take place in such a mixture, or how (if these changes took place) the mixture resulting might affect plant-leafage, I applied for information to our excellent authority, Dr. J. Aug. Voelcker, Consulting Chemist of the Royal Agricultural Society of England. He kindly gave me the following clear account of the changes which occur to Paris-green when acted on by an alkali variously applied; some serviceable remarks as to extent of change depending on amount of free alkali, and strength of the soft-soap solution; and likewise the result of the experiments which he was good enough to make by way of practical test, which information, with his kind permission, I give *verbatim* :—

"Aceto-arsenite of copper (Emerald-, or, as now called, Paris-green), whilst it is insoluble in water, is acted upon both by acids and alkalies, with the result that copper is thrown out. With an alkali a blue precipitate of cupric hydrate is first formed, and if this be *boiled* with the solution it changes to the black cupric, and then to the red oxide.

"Now, whether this takes place with mixing soft-soap solution and Paris-green depends mainly upon what amount of free alkali is present, and what the strength of the soap solution be. *Theoretically* there should be *some* separation, inasmuch as soft-soap always has some alkali.

"I thought, therefore, the best way was to make a practical test in my laboratory before writing to you, and this I have done, and may now give you the result thus:—If a very strong (28 lbs. soap in 10 gallons of water) solution be used, there is a certain amount of change; but if a solution of lesser strength, and more like the one recommended for Hop-washing purposes (28 lbs. in *100* gallons) be used, there is no appreciable change."—A. J. V.

The above gives very clear information available for practical use, as to addition of Paris-green to soft-soap in solution; but further we needed information on conditions of mixture in solid form, that is, of Paris-green added to soft-soap itself, forming a kind of paste to be dissolved in water for use.

Regarding this, Dr. Voelcker further wrote me, on the 17th April, mentioning that, from my letter received that morning, he concluded that a mixture regarding which I wrote was soft-soap and Paris-green, not merely making a solution of the soap, and to that weak solution to add the Paris-green; and of this he observed :—"Now this is to my mind distinctly open to objection, and I should not countenance it on

several grounds. If one mixes soft-soap direct (and in weak solution with water) with Paris-green, you get a *decidedly alkaline* mixture, and the circumstances thereby induced which would tend to cause the copper (as explained in my last note) to be partly thrown down. It might not happen in a weak solution, but would be much more likely to do so if soap and Paris-green were directly mixed.

"The remark in your letter as to the change of colour you noticed in the outside portion makes me think that partial reduction has actually taken place, and if so, that means a change of composition. I have to-day made such a mixture, and will keep it to see what happens.

"But there is yet another great objection: the soft-soap may simply be a cheap medium for 'wrapping up' in it a *little* Paris-green, and making it look a *lot*. If the purchaser wants such a mixture he had better get the separate materials himself and mix them; then he may have a fair chance of getting the right amount of 'green,' otherwise he will not.

"Lastly, the mixture is a difficult one to mix up in water, at least in cold water. I would certainly advocate the 'unmixed' material for purchase."—A. J. V.

The above-mentioned experiment Dr. Voelcker carried out, and on April 28th further wrote:—"I have now kept the mixture of Paris-green and soft-soap, which I made for some time, and have compared it with the tin of the similar compound which you sent me.

"The appearance which the two present are identical.

"As I said to you before, there is a change to a certain extent in the composition, which is indicated by the darkening of colour noticed by you, and called by you the olive-greenish colour." . . . . . Dr. Voelcker made some observations here in reply to remarks on various colouring which I had noted, and then proceeded:—"That there has been a change is quite enough to make the application of the term 'Paris-green' not altogether a proper one, for it is no longer the aceto-arsenite of copper. Whether, however, its properties are destroyed or not is another matter, and, seeing that the evidence we have so far goes to show that any salt of copper acts as a preventive against mildew, one cannot say that the mixture has produced a body no longer possessing the virtues of the copper compound." . . . . "The mixture of soft-soap does not remove the copper, nor yet the arsenic; they both remain there." . . . . . After some further observations, Dr. Voelcker added:—"And again I call the mixture a very bad one for mixing up with water; it is a sticky, pasty mass that wants a lot of rubbing about; ordinary stirring in water does not do. It would be much better to stir the pure Paris-green up in a soft-soap solution. I

see no advantage, but rather disadvantage, therefore, in the use of the mixture."—A. J. V.

The above clear observations of Dr. Voelcker's require no comment; and I felt myself much favoured in being thus aided to place the exact state of the case regarding admixture of Paris-green and soft-soap before those to whom a certain knowledge of what they are dealing with is of great importance. With regard to the mixture itself, I can quite endorse Dr. Voelcker's views as to its being a tenacious sticky mass most difficult to deal with, and also involving great uncertainty as to proportion of Paris-green therein contained. Consequently there may be more or there may be less than the quantity needed, and great difficulty or loss ensue. In these observations the matter under consideration was solely mixture of Paris-green with soft-soap.

About the same time, being then in correspondence with Mr. James Fletcher, the Entomologist of the Dominion of Canada, who assisted us greatly in the first trials of use of Paris-green in England, I mentioned the subject, and he subsequently favoured me with the following notes of experiments carried out by Mr. Frank Shute, the Chemist of the Experimental Farms of the Dominion of Canada. These (which, it will be seen, especially regard whether the poisonous action of the Paris-green is changed by mixture with solution) deal with chemical changes, or changes in condition, which are caused to Paris-green by various combinations specified; also give notes of results of experiment of mixtures of Paris-green with various kinds of soaps, alkaline, or not alkaline to test paper; and notes of the inferences to be drawn from the experiments. I beg here also to express my best thanks for the favour of being permitted to offer such useful information for general service; and I give the report as follows:—

"Laboratory, Central Exp. Farm, Ottawa, Canada,
"June 9th, 1891.

"*The application of Paris-green in soft-soap solution as an insecticide.*—The question has arisen whether the toxic action of Paris-green as an insecticide is to any extent weakened or destroyed when the poison is applied with soap solution. For the purpose of answering this question I have carried out a number of laboratory experiments, the results of which form the basis of the present report.

"Paris-green (aceto-arsenite of copper) is an emerald-green salt, which is *practically insoluble in water*. Experiment 1 consisted in shaking up Paris-green with water constantly for more than a week. The Paris-green was then filtered off. Not a trace of arsenic could be detected in the filtrate, though the most delicate chemical process was employed.

"Strong ammonia readily and completely dissolves Paris-green,

forming a deep blue solution, and capable of being diluted with water without decomposition or precipitation.

"The fixed alkalies, potash and soda, in strong aqueous solution decompose this poison, the blue hydrate of copper separating. This on heating first becomes changed into the black oxide, and finally the red cuprous oxide, the arsenic going into the solution as potassium arsenite.

"A number of experiments have been tried as to the solvent action of different soap solutions on this insecticide. The soaps used were (1), whale-oil soap; (2), common brown soap; (3), 'English' soft-soap.

"The whale-oil soap strength (1 lb. to 8 gallons of water) was not alkaline to test paper. The Paris-green was shaken up with this solution repeatedly for five days, and the mixture then filtered. Not a trace of arsenic could be detected in the filtrate, showing that no decomposition of the Paris-green had taken place. The latter retained its bright green appearance throughout the experiment.

"The solutions of the 'common brown' soap, and 'English' soft-soap, were not of any stated strength, but were as strong as it was possible to make them. By this means, a severe and extreme test was made in each case.

"The common brown soap was strongly alkaline. Its solution was found to *slightly* decompose the Paris-green, arsenic being detected in the filtrate in *traces* after acting upon it for five days. The residual Paris-green was, however, bright green, which, together with the fact that but traces of arsenic passed into solution, shows that only to a very slight degree had the poison been acted upon.

"With the 'English' soft-soap solution, which was much more strongly alkaline than the preceding, there was more decomposition, *i. e.*, more arsenic passed into solution, and more copper precipitated, than in the experiment just cited. The treatment was similar as in the previous trials, and the result showed that heavy *traces* of arsenic had passed into solution, while at the same time a slight brown deposit of oxide of copper was to be noticed on the residual Paris-green.

"If it were necessary for the efficacy of the poison that the Paris-green be applied in such liquids as would have no decomposing or solvent action upon it, the results of these experiments show that no practical harm or deterioration would result from using it with soap solution. When it is remembered, however, that Paris-green, though insoluble in water, passes, more or less rapidly, into solution by the action of the digestive fluids before its toxic effects can be conveyed throughout the insect's body by the circulatory system, there seems to be no good ground for condemning an application in which traces of arsenic are already soluble. The chief reason against the use of

white arsenic, is on account of its injurious effect on foliage, it being soluble in water and acid in its character.

"The arsenic set free in the soap solution is neutralized by the free alkali of the soap, so that where soap solution can be used *per se* without harm, no injurious results from soluble arsenic need be apprehended when to it is added Paris-green in the right proportions.

"In all the above experiments the soap solution was at the ordinary temperature of the atmosphere when added to the Paris-green. If heat had been used undoubtedly a larger portion of arsenic would have gone into solution."—FRANK T. SHUTT, M.A., F.I.C., F.C.S., Chemist, Dom. Expl. Farms.

PLUM.

Plum Sawfly. (For scientific names, see note, p. 84.)

During the past season, I received from a few different localities specimens of young Plums infested by Sawfly grubs, which were obviously doing much mischief by clearing out the young kernel, and sometimes further injuring the centre of the fruit, and consequently causing it to fall very prematurely.

On the 22nd of June, I received a communication from the Rev. Henry H. Slater (Urchester Vicarage, Wellingborough), mentioning that his Plums were heavily attacked by a grub which he was not able to identify, and he therefore forwarded a few of the fruit for examination. He remarked:—"It appears to me that the attack has been made and the eggs introduced very shortly after flowering, because, when the puncture occurs at the extreme end of the fruit, the exuding gum has often fixed the remains of the flower. I should say that the creature has injured quite half the crop."

The injured Plums varied in size from about, or a little over, half-inch to an inch in length. In somewhere about nineteen examined, I found the fruit usually to have one boring near the end opposite to the insertion of the stem. In a few cases there were two injured spots; the tunnels were sometimes open, sometimes choked with black gummy material.

On opening the fruit I found the kernel gone, and often some amount of marks of gnawing round the cavity where the kernel had lain; this cavity being more or less filled with blackish decayed matter.

The larva was rarely present in any of the fruits which I opened sent me by Mr. Slater, but, where present (either amongst these or amongst the specimens sent me from Toddington), I found them to be twenty-footed caterpillars. That is to say, they were furnished with three pairs of claw-feet; six pairs of ventral sucker-feet; and one pair of sucker-feet at the end of the tail; ten pairs in all.

The general colour of the larva or caterpillar was whitish; head chestnut, darker in front or on the jaws; eyes dark or black. In such specimens as I examined, the caterpillar lay curled in the injured fruit, somewhat in the manner of a Cockchafer grub, but when disturbed and placed on the hand, it walked swiftly along it. On further examination a few days later, I found the length of the specimen (exactly measured) was five-sixteenths of an inch,—the head pale chestnut, general colour yellowish, the shape somewhat pointed towards the tail, and also it *emitted a strong smell.*

About the 22nd of June some Plums, similarly infested by Sawfly caterpillar, were forwarded to me from Toddington (Gloucester), by Mr. C. D. Wise. He mentioned, "We picked the Plums and destroyed them"; and on the 14th of July he further observed:—"I am sorry we could not let you have any more fruit of the Plum with the caterpillar still in, as after your letter we were unable to find any more; by this you will see our attack was not severe, and the grub must have been about full grown when we sent it to you. I do not find that the Plum Borers attack any special kind of Plum more than another." The infestation was also stated to be bad in the Evesham district.

Presumably the plan mentioned above by Mr. Wise would answer excellently for preventing recurrence of the attack, as thus the caterpillars would be destroyed before they had the opportunity of burying themselves, and going through their changes to the perfect Sawfly. These good results are shown in the following extract from a letter sent me on the 29th of June, from Seaford Grange, Pershore, by Mr. W. F. Gibbon (Chairman of the Evesham Fruit Growers' Experimental Committee):—"Regarding the Sawfly larvæ in the young Plums. Last year I noticed a lot of them, and had all the dropped Plums daily gathered up and burnt. This year I find a bored Plum dropped only here and there."—(W. F. G.)

In the case of this infestation, I have merely distinguished it by the name of "Plum Sawfly," as I have only had the opportunity of studying the larvæ during a short part of their lives; in all points, however, which I had opportunity of observing, the condition of the Plums and the appearance of the caterpillars corresponded with the long and full accounts of Plum Sawfly given respectively by Dr. Taschenberg, Dr. Ritzema Bos, and also by Canon Schmidberger,

under different scientific appellations, thereby adding not a little to the perplexities of the subject.*

The life-history of the Plum Sawfly, as given by the above writers, is, in its main points, as follows. The female Sawfly begins her operations by making a slit in a calyx leaf of a Plum blossom, or expanding bud. Apparently only one egg is laid in each blossom (or rather calyx). The egg is very small, geenish white, and transparent. The caterpillar hatches in from about a week to a fortnight's time, and eats its way into the young embryo fruit, where it continues within what would have been the kernel, and when it has consumed all that suits its purpose for food in one Plum goes on to another. This caterpillar is (as we observe of our own) twenty-footed. The colour whitish, or with a reddish-yellow tinge; head dark brown or yellow; body lesser towards the hinder extremity, and it gives out a strong bug-like smell.

The caterpillar is full grown in a period variously observed as from three to four, or five to six, weeks. Then the young Plum falls, the caterpillar creeps out, buries itself in the ground, where it spins a cocoon; here it is stated to spend the winter, still in the larval state, and in spring to change to the chrysalis or pupal state, from which the perfect Sawfly comes out in time to lay her eggs amongst the opening Plum blossoms. The flies are somewhat like the Apple Sawfly, figured at page 1, with two pairs of transparent wings. The general colour black or shining black; legs mostly yellow, or of a reddish or brown yellow.

The above notes of life-history are taken from the observations of Dr. Taschenberg, Dr. Ritzema Bos, and Canon Schmidberger, published in their respective works referred to above.

Means of prevention and remedy (also given by the same observers) consist, for one thing, in collecting and destroying the infested little

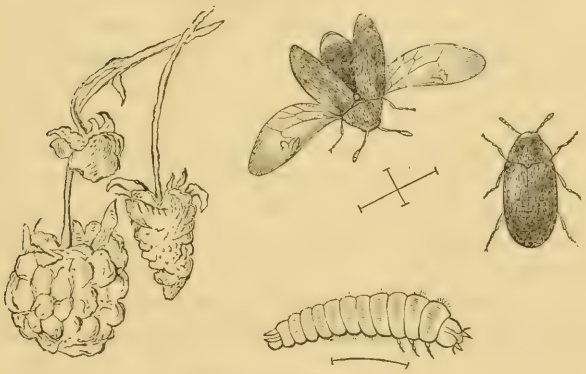
* In the 'Praktische Insekten-Kunde' of Dr. Taschenberg, the name given is that of *Hoplocampa fulvicornis*, Klug.; in the 'Tierische Schadlinge und Nützlinge' of Dr. Ritzema Bos, it is *Selandria fulvicornis*, Klug., and the internal evidence of quotation in each of these papers shows it to be the same insect of which a very good account is given by Schmidberger in 'Kollar's Insects,' under the name of *Tenthredo morio*, Fab. A short account of the infestation corresponding with the above, so far as a few lines can correspond with full descriptions, is also given in Kaltenback's 'Pflanzenfeinde' under the name of *Selandria fulvicornis*, Klug. It is, however, very requisite, in mention of the *Tenthredo morio*, Fab., to mention also the name of the authority by whom it is so called, as the *Selandria=Tenthredo morio*, Fab., of Cameron's 'Mon. of the British Phytophagous Hymenoptera' (vol. i. p. 199), and the *S. morio*, Fab., of Taschenberg's 'Insekten-Kunde,' are clearly different insects from the *T. morio* of Schmidberger, inasmuch as the caterpillar is stated to have a green body spotted with black, whereas the colour of the caterpillar of the kind described above is whitish or yellowish.

Plums before the caterpillar within can leave them to bury itself. This may be done by jarring or shaking the trees, so as to cause the damaged fruit to fall, and having this fruit immediately gathered together and destroyed before the grub within escapes. Or the infested fruit may be picked from the trees by choosing such of the little unripe Plums as show a black spot, where the sap and black rejected matter from the grub have run down its tunnel and show at the outside.

Also it is stated that the black Sawflies are sluggish, and when they are occupied in egg-laying, or in sucking honey from the Plum blossoms, that they may be caught by hand where they are in reach on low-growing trees.

RASPBERRY.

Raspberry Beetle. *Byturus tomentosus*, F.



BYTURUS TOMENTOSUS.

Raspberry Beetles, much magnified, with line showing nat. length; maggot, magnified, with line showing nat. length, after sketch by Prof. Westwood. Raspberry fruit.

The *Byturus tomentosus* is a small beetle of some shade of brown, which may vary from pitchy to reddish or yellowish, but covered with such a thick yellowish or grey down as to conceal the ground colour. The horns (which are thickened towards the extremity so as to be somewhat club-shaped) and the legs are reddish yellow, or reddish yellow with a brown tinge.

These beetles are to be found in spring (after they have developed from the chrysalis state) infesting various kinds of flowers, but especially those of Raspberries. Here they do an immense amount of

mischief when they are numerous, as was the case last year in Raspberry plantations, but this was not all. The female beetles lay their eggs by the still slightly developed Raspberry fruit, and the maggots, which presently hatch from these eggs, feed on the fruit until it and they both reach maturity, and the fruit, if not totally destroyed, is at least made unfit for use. The maggots grow to a length of about a quarter or five-eighths of an inch, and are cylindrical, somewhat depressed in front, and lessened at the hinder extremity, which is "terminated above by two brown curved points, and beneath with a cylindrical tubercle employed as a proleg." They have three pairs of moderately long, hairy feet. The colour is yellowish with brownish yellow on the back, the head brown.

When the Raspberries are ripe, the maggots leave the fruit and seek for some cranny under the bark, or in the wood of the Raspberry stem, or some similar sheltering-place, where they form a cocoon or case in which they turn to the pupal state, in which they pass the winter, and from which the beetles come out in the following spring to attack the Raspberry blossoms.*

This attack is one which, like many other of the fruit insect attacks, is either steadily increasing both in area and amount of damage caused by it, together with the increasing area of fruit crops grown year by year on one spot, or is much more noticed than was formerly the case. In the course of my fifteen years reporting, I have only once before (in 1883) received observations regarding the infestation which pointed to it as one of serious moment; and now it will be seen by the following notes that the attack was present in its beetle form very noticeably in the great Toddington Fruit Grounds, and in various localities in Kent. It was also reported from one locality in Essex, one in Herts, and one in Cambridgeshire, and also from the well-known fruit grounds of Mr. Speir, near Glasgow, and from the east of Perthshire.

In the past season, the first notice I received of this infestation being present, was sent me on the 26th of May, by Mr. J. Green, fruit grower, of March (Cambridgeshire), who forwarded specimens of the *B. tomentosus*, with the remark that they were sent as "samples of a Raspberry beetle which is doing damage to the Raspberry crop in this neighbourhood this spring. You will notice from the buds, also enclosed, the manner in which the damage is being done."

* The above description of the larval state of the *B. tomentosus* is taken from collation of the accounts given respectively by Prof. Westwood, in his 'Classification of British Insects,' Dr. Ritzema Bos, in his 'Tierische Schadlinge und Nützlinge,' and Dr. E. L. Taschenberg, in his 'Praktische Insekten-Kunde,' as I have only personal knowledge of the *Byturus* larvæ in their full-grown state in the ruined Raspberry fruit.

On June 1st, specimens were sent by Mr. J. Temple Johnson, from Sutton Court, Dartford, with the note, "I enclose some small brown beetles, and some Raspberry blossoms injured by the same. These beetles are very numerous this year"; and a few days later a further supply of the beetles were forwarded, together with Raspberry blossom in various stages of consumption, and the further observation, "You will see that it is quite finished off, and if some remedy is not found the whole crop will be destroyed."

On the 3rd of June, Mr. C. D. Wise noted of this same beetle, that they were feeding in quantities on the Raspberries in the Toddington Fruit Grounds (near Winchcombe, Gloucester), and observed on its habit of feeding by day as a distinction between this and the night-feeding Raspberry weevils, which at first it was feared they might be. On the 11th of June Mr. Wise wrote me with regard to remedial measures, "We have been shaking the bushes over bags soaked in paraffin with excellent effect."

The same attack was noted by Mr. P. R. Morse, of Wickham, Bishop Witham, Essex, on June 8th, as that of a little beetle that attacks the bloom of the Raspberries, and appears, in some instances, quite to destroy it. Mr. Morse observed that it was found quite at the bottom of the bloom where the fruit is forming, and that he heard it was very general in Kent; but with him, and from what he could learn, it was not doing so much harm as the Kentish attack. About a week later, Mr. Morse wrote:—"I do not find so many of the Raspberry Beetles now, and do not think they will do me much harm this year at any rate."

From Halstead, Sevenoaks, on the 12th of June, they were reported by Mr. W. Bowen as "insects that are very troublesome in our Raspberry plantations, and doing very great damage just now"; and from Knockholt, also near Sevenoaks, in Kent, Mr. James Wood forwarded me specimens of the *Byturus*, and also of the *Otiorhynchus picipes*, the "Clay-coloured" Raspberry Weevil, as samples of the insects "which have caused so much damage in our Raspberry and Strawberry plantations. Mr. Wood remarked, "I have been a grower for this last twenty-five years, and during that time have never known so much destruction before." Notes of another locality of Kentish attack of this kind of beetle were also sent by Mr. W. L. Wigan, from near Maidstone, with specimens accompanying, and the observation, "There are sometimes five in one flower. They fly readily; they lie in the trough round the base of the embryo fruit."

From Much Hadham, Ware, Herts, the following good note of method of attack of the beetles on the buds was sent me on the 17th of June, by Mr. M. L. Gayton:—"They are doing much damage to a small garden Raspberry plantation. I first noticed them when the

flower-buds were forming; apparently piercing a hole in each bud. Now as the buds are opening, they seem to be eating the stamens and petals. I have killed quite two hundred in a short time, generally two on every bud."

From much further north, namely, from Newton Farm, near Glasgow, Mr. John Speir sent me specimens, on the 13th of June, with the remark that "the enclosed small brown beetles are making considerable havoc on the remaining canes of my Raspberries. They eat away the flower-bud." Various localities also in west Perthshire apparently suffered from the same trouble, as on the 30th of June, Sir James T. Stewart Richardson, of Pitfour Castle, near Perth, directed my attention to complaints, then appearing in the 'Dundee Courier' from district correspondents, regarding a very destructive beetle which had attacked the Raspberry. Two of the localities where the infestation was reported as being injurious were the neighbourhoods of Scone, which is a few miles from Perth, and Alyth, on the border of Perthshire and Forfar. As I had not (as in all the other cases of this infestation) specimens sent me for examination, I cannot be certain that this attack was of the *Byturus tomentosus*, but as the attack was described as of a voracious little black beetle, which fed on the Raspberry blossom, it is presumable it was of this kind.

All the above observations, it will be noticed, refer to the attack of the *Byturus* beetle to the flower or blossom bud of the Raspberry, the first application being sent on the 26th of May, and enquiries or remarks on presence of attack being continued until the last day of June. This injury, however, which is caused by the beetles to the blossoms is only one portion of the mischief. Following on this is the harm done by the maggot in the Raspberry fruit. Of this I received very thorough examples from Toddington, sent me by Mr. Wise on the 19th of August with the following observations :—

"I am sending you some Raspberries which will, I fear, arrive in a pulp, but at this time of year they are so very soft. In them you will find a quantity of grubs, and our Raspberries are infested with them. Can you tell me what they are ?"

These I carefully identified from descriptions as being maggots of the *Byturus* beetles of which so many had been seen earlier in the year, and of which the chief characteristics are given at pp. 85 and 86, and on forwarding the information received the following confirmatory note from Mr. Wise :—

"I looked out the Raspberry Beetle, on the evening I sent you the grub, in your Report of 1883, and thought they were our old friends. I think they are more plentiful this year than I have ever seen them, and you will remember in the spring of the year we were very much troubled with the beetle."

Presumably a little search into the cause of damage would have shown plenty of "Raspberry maggot" present at other infested localities, but no other specimens of this part of the attack were sent me.

Prevention and Remedies. — The most available method appears to be shaking off the beetles in such a manner that they may have no chance of escaping and flying back to the Raspberry blossoms, and no better plan appears to be mentioned anywhere than that mentioned by Mr. Wise at p. 87, of shaking the infested bushes over bags soaked in paraffin oil. Anything (as for instance, cloths, tarred boards, or baskets tarred inside) into which the beetles would fall, and from which they could not escape (whether from being poisoned or stuck fast), would answer well. But in any case the operations should be carried on early in the morning, or when the beetles will be dull and sluggish. "On hot days these little beetles fly away directly they are alarmed."

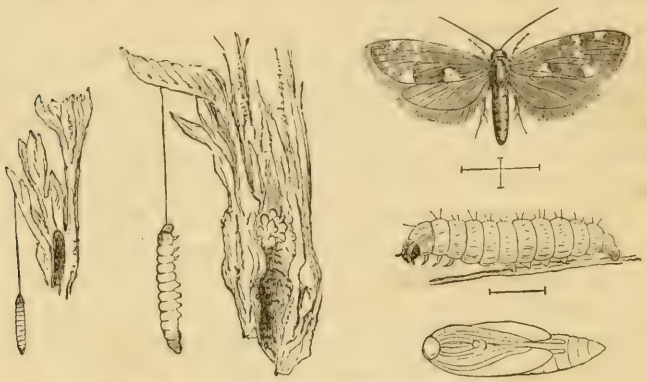
If it were possible to have the fruit, which from its ruined condition is noticeably infested by the maggots, gathered and burnt, this would save much recurrence of attack. The only other available methods of prevention appear to be—1stly, so clearing away all old wood, and places in which the chrysalids may be sheltered, that they may thus be got rid, or, to a great measure, got rid of at the bushes. But, 2ndly, though I do not see this plan has as yet been brought forward, it seems not unlikely that, as these little chrysalis-cases are stated to be formed in crannies under the bark, or in the wood of the Raspberry-stems, there may be many hidden about the bearing-stems of the past season which are regularly cut away in course of ordinary treatment. If so (unless these trimmings are destroyed), the beetles which come out from them in spring would be a most fertile source of infestation to the neighbouring blossoms. As in any case the old bearing wood must be cut away, it would add little to expense (where this is not already practised) to burn it, and it might be that this would strike at the root of much further mischief.

Red-bud Caterpillar. *Lampronia rubiella*, Bjerk.

The mischief caused by this attack may be readily known from that caused by the *Byturus* beetle and its maggot, mentioned in the foregoing paper, by reason of it affecting the inside of the young buds, or shoots, or pith, whilst the beetle attacks the Raspberry blossom, and the beetle maggots afterwards are to be found in the fruit.

The "Raspberry-bud" moth caterpillars are about a quarter of an inch long, of some shade of red, with black head, and black mark on

the following segment; they have three pairs of claw-feet, which are black, and also four pairs of sucker-feet, and a pair at the end of the tail. When examined through a magnifying glass it will be seen that there is a pale line down the centre of the black head, and that the mark on the following segment is composed of a pair of double-spots.



LAMPRONIA RUBIELLA.

Moth, magnified, and with lines showing nat. size; caterpillars, nat. size, and somewhat magnified from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood in 'Gardeners' Chron.' for 1853, p. 757.

The attack is begun in spring by the little caterpillars (which live in the caterpillar state through the winter) piercing into the young buds, and with the advance of the season the mischief becomes very noticeable by the fading of the young shoots which have not been destroyed whilst still in bud condition. The infestation was described many years ago by Prof. J. O. Westwood, in the volume of the 'Gardeners' Chron.' for 1853, with good illustrations, from which I borrow the characteristic figures of the caterpillar and chrysalis, much magnified, given above. Of late years it has been occasionally noticed, but I have never received any special report of it since 1883 until its mischievous outbreaks in the past season, which have given opportunity of adding very serviceable information to the previous observation of its life-history.

Some of the first observations of the presence of the caterpillar were sent in last season much about the same time from Toddington in Gloucestershire, and from near Glasgow, and from Crieff in Scotland.

On the 2nd of May, Mr. Wise wrote from Toddington, "I am sorry to say the red maggot in the Raspberry is increasing in an ALARMING extent in spite of our picking off all we could last season."

The specimens sent me in infested buds corresponded with description of the larvæ of the *L. rubiella*, and later on I received a specimen

of this moth bred by Mr. Doeg, of Evesham, from larvæ taken in Raspberry shoots at Charlton, belonging to Mr. John Swift. On the 6th of May, Mr. Wise wrote me, "We have picked off every shoot which was affected."

On the 30th of April Mr. Speir, writing from Newton Farm, Newton, near Glasgow, observed:—"On my Raspberry canes to-day, I came on a large number of small scarlet maggots on almost every other cane. They are about three-sixteenths of an inch long, and one-twentieth thick. It has a black head and a small black spot on its tail, but otherwise is all bright red. Up until a couple of days ago, we have had no mild weather since February, much less warm weather, and it is only within that time that the buds have swelled any. Most of these maggots I found crawling on the canes, but quite a number were just emerging from the buds, and on cutting off a number of buds, I found either a burrow from the base to the apex, or a maggot in the base, in a great many of them."

The above observation of Mr. Speir's, regarding the fact of maggots being emerging from the buds is very important practically, as showing the successive injuries which are caused by one caterpillar, and this is fully confirmed by the following note sent me by Mr. Wise on the 6th of May:—

"I am much obliged to you for sending your Report for 1883. I do not agree with Mr. Weir, on page 67, when he states 'that in no case were the caterpillars found to leave the bud which had been attacked, each caterpillar only destroying one shoot.' I have found in cases where there are two shoots the caterpillar has been in one and left it, and evidently gone into the next, for in the next I have found it."

On May 7th the Rev. W. P. Paterson, writing from The Manse, Crieff, N.B., forwarded me specimens of the red maggots with black heads, and mark on next segment, and at tail, of the *Lampronia rubiella*. The buds on the pieces of cane accompanying were not nearly so far advanced in growth as those sent from Toddington, and in one instance I found the red caterpillar well down at the bottom of the bud as described below. Mr. Paterson, after mentioning severe injury from some kind of insect attack which in the previous year reduced the yield of an acre of "rasps" from £40 to £8, further observed:—"On examining the plantation to-day, I find most of the buds eaten like specimen (1), in which, in a few cases, a red maggot (specimen 2) was found snugly ensconced at the root of the bud. I suspect that the crop is again destroyed."

Somewhat later on Mr. Paterson favoured me with the following further communication, which is well worth study, regarding the point alluded to in above observations. Mr. Paterson remarked:—"On

page 67 a correspondent informs you that the larvæ entered the shoots when about an inch long. Here many of the buds have been entered when they have barely stirred (specimen 1). He says further, 'that as far as can be seen each caterpillar only destroys one shoot.' I doubt this, while I believe that the caterpillar does not leave the bud when once he has penetrated to the pith of the cane, where he makes his lair; I think that he may often nibble at one or two buds on his way up the cane, and thus destroys them before finding one which pleases him as a permanent settlement. Specimen 2 shows three lower buds which have been seriously bitten, while the only nest is in the fourth or topmost bud.

"I have also seen a caterpillar travelling from a bud, out of which the heart had been eaten, to one higher up, in which he buried himself. I cannot say that I saw him emerge from the lower one, but the traces of damage were quite fresh. In some cases I have found that the cane died away above the joint at which the caterpillar had made his bed in the pith."

The above notes are well worth attention, for in them, from one or other of three observers of Raspberry growing on a large scale, we have information of the little red caterpillars being observable straying about the canes as soon as growth of the buds begins, and of their power of causing damage, not only by an individual maggot establishing itself in a bud, but also by each maggot trying, as it were, successive buds until it finds one to its fancy, and even then if supplies fail, quitting the destroyed bud for a new home.

The following note was sent me, on the 12th of May, from Preston Farm, Shoreham, Sevenoaks, Kent, by Mr. J. Beale, with specimens of both the Raspberry (*Byturus*) Beetle, and of the caterpillars of the *L. rubiella*, the Raspberry Moth. Of the latter Mr. Beale observed:—

"I do not think it is anything fresh, but it is the first time I have observed it. In fact I thought it was the frost that had touched the shoots, till a friend from St. Mary Cray came down and showed me the larva in the shoots; he told me he had some ten to fifteen acres so badly damaged that they looked as if it might be the middle of winter. I am having the affected shoots picked off and burnt." *

On May 18th Mr. E. Vincent V. Wheeler, of Newnham Court, Tenbury, Worcestershire, forwarded me specimens of the *L. rubiella* caterpillars then beginning to spin up and change to the chrysalis state. Mr. Wheeler wrote:—"I am sending you specimens of a small red caterpillar which is attacking the Raspberries this year, it has eaten all the first buds, and eats its way into the cane itself. We

* Mr. Beale also noticed the great number of the beetles (of which he sent specimens, showing them to be *Byturus*) which were present.

have not noticed them in previous years, and should be glad if you could give us any information."

One of the caterpillars sent had spun up except at head end, colour become yellower below. A chrysalis (spun up in web in the bud) was tawny or reddish yellow on as much of the back from the head onwards as was visible. The wings, which were folded beneath it, were yellowish. The abdomen was of a full pink.

A few days later, Mr. Wheeler forwarded me a further supply of buds, with the observation "that the new shoots seemed to be free from attack, but most of the first buds have been destroyed. We have already picked out most of the diseased buds, so that we have had some difficulty in finding any more."

The above observation was satisfactorily completed by a characteristic specimen of the moth *Lampronia rubiella* developing from a chrysalis in one of the Raspberry buds sent me from Newnham Court. This I first observed to have emerged on June 1st.

The following are the main characteristics of the appearance of the moth; see also figure at p. 90. The expanse of the wings is a little under half an inch. The head ochry grey with yellowish face; horns dull brown. The forewings shiny, with a brown ground, marked with yellow dots and various yellow spots; of these spots two are very noticeable on the hinder or inner margin, and there are four smaller spots on the costa or fore edge. The fringes are brown, with tips white at the end of the wing. The hinder wings brown, with paler fringes.*

The observations contributed this year give a very fairly complete history of the life of the insect, from the first appearance of the young red caterpillars from their winter shelters to the development of the moth. We find them straying about the Raspberry canes whilst as yet the buds are hardly sufficiently grown to receive them, and presently in full tide of mischief migrating from one bud to another, and as the plant growth goes on we have notes of the young shoot failing beneath the presence of the pest within, almost as if they had been frost-bitten. From specimens sent, I had opportunity of noting the colours of the chrysalis spun up in the bud, which I am not aware of having been recorded before, and also reared the moth.

Here we have the history of most of the attack agreeing in most parts with what we had general observation about before, but the intermediate history (that is, where the moth which is known to be common in June lays her eggs, and where the young caterpillars feed before they hide up for the winter) was, I believe, unknown until

* For description in precise scientific wording, with synonyms of the species, see Stainton's 'Tineina,' p. 39.

observed and recorded last year by the well-known entomologist, Dr. T. A. Chapman, of Hereford.

Observations were given, very many years ago, on (I believe) the authority of Bjerkander, that the moths laid their eggs on the Raspberry-stems, and they were stated to feed on the foliage. In Stainton's 'Tineina' (p. 39), the author just shortly states, "The larva feeds under the fruit when young, hybernates without feeding, and in the spring bores down the stems of the young shoots." But the following extracts from Dr. Chapman's published account of his own observations, appear to me conclusive as to the method and place of egglaying of the moth.

Dr. Chapman wrote* :—"The egg of *L. rubiella* is laid when the Raspberry is in flower; I have twice seen the process take place, and on one occasion besides saw it fail. The moth selects a fully open flower," and here Dr. Chapman gives a minutely detailed account of the operation of egglaying, culminating in the egg being inserted in the "receptacle" of the flower, so as to lie about its own width beneath the surface. In the case of failure mentioned above, the moth had attempted to lay on a not fully opened flower.

Further, quoting Dr. Chapman's words:—"When the Raspberry is ripe, and is removed by human or other agency, the larva of *rubiella* is in the fleshy white receptacle,† but is ready to quit it, and does so immediately. In one such receptacle were two larvæ. So far as I could see, their presence does not interfere with the due development and ripening of the fruit."

From further observations, Dr. Chapman found that the larva spins itself a little round, flat, white, silk cocoon not much more than the twelfth of an inch in diameter, and that on its leaving the "receptacle" (which he notes may be in the way mentioned above, or by boring a way out at the base by the footstalk) that it no doubt goes down to the stool of the plant, and passes the winter in such a cocoon as he describes, from which it emerges in the spring.

Prevention and Remedies.—One of the most effectual methods of checking recurrence of attack must certainly be that mentioned above, of breaking off the infested buds, or little shoots, and destroying them. At the visit of the Evesham Fruit Experimental Committee to the Toddington Fruit Grounds, on the 12th of May, a large basket was shown filled with Raspberry shoots infested by the caterpillar of *Lampronia rubiella*, as a sample of several other basketfuls which had

* See paper in number of 'The Entomologist's Magazine' for June, 1891, p. 169, entitled "The oviposition and autumnal larva of *Lampronia rubiella*."

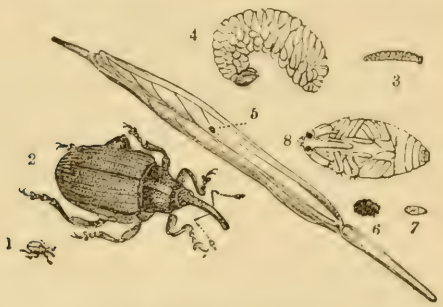
† For figure of "receptacle" of Raspberry fruit, with the berry removed, see sketch of Raspberry at p. 85.

been collected in the previous part of the day. This method of clearing the pest, however, requires some care in carrying out, for, as shown above, the caterpillar by no means necessarily remains in its own bud. Very likely at Toddington some plan would be adopted to keep the caterpillars from straying; but (if nothing else occurred) probably a rough lining of canvas, fixed inside the collecting-baskets, which would allow of a good sprinkling of paraffin oil being given to it, and so prevent escape over the edges, would probably be a good plan. In any case the infested shoots should be burnt, or destroyed in some way as soon as possible, or otherwise, in case the caterpillars are so nearly full grown as for the time of their change to chrysalis to be at hand, almost as plentiful a development of the moth may be expected from the gathered shoots as if they had remained on the bushes.

No attempts appear to have been made at present to prevent the attacks of the little red caterpillars when they come out from their small white silky cocoons, or from the sheltering-places where they have passed the winter. But where there is reason to expect bad attack, it might be worth while to try the effect of some preventive dressing thrown round the base of the canes. Such an application as ashes, or dry material sprinkled with paraffin oil, in the proportion of a quart of the oil to a bushel of the dry material has been found to do no harm to the young Hop shoots coming up through it, and would be at least worth trying on a small scale, if not applicable on the broad scale of farm gardening.

TURNIP.

Turnip-seed Weevil. *Ceutorhynchus assimilis*, Payk.
Flower Beetle. *Meligethes æneus*, Fab.



CEUTORHYCHUS ASSIMILIS.

Beetle, maggot and chrysalis, nat. size and magnified; infested Turnip pod.

The following notes refer to two kinds of beetle attack affecting the flowering shoots of Turnips and other plants of the Cabbage tribe, and which by injuring the blossom buds, blossoms, unripe seeds, and in some cases the shoots themselves, materially lessen the amount of the seed crop. These two kinds of beetles are respectively the "Flower Beetle," scientifically the *Meligethes æneus*,* and the "Turnip-seed Weevil," scientifically the *Ceutorhynchus assimilis;* but as the "Seed Weevil," though especially injurious when in maggot state to the young forming seed, feeds when in beetle state partly on the flowers; and the "Flower Beetle," whether in beetle, or in maggot state, so injures the flower, and the fructifying parts, that it lessens amount of seed; and also as both kinds of beetles are often to be found together on the flowering shoots of the Turnips, or other plants which they infest, it has seemed best to notice the two attacks together.

The Turnip-seed Weevil is a small blackish or greyish beetle, not quite the sixth of an inch long including the proboscis. The shade of colour depends very much on whether the specimens are fresh, or rubbed. The beetles are black, with a sprinkling of fine white hairs above, and scales below, which give a greyish tint, and when these are rubbed off, the beetles look black or patchy. The wings are ample, and thus the insect has great powers of dispersing itself around.

The life-history, as given by various writers, is, that after hybernation during the winter, the weevils of the preceding autumn come out again in the following spring, and appear on the flowering shoots

* As mentioned further on, the *Meligethes viridescens* may also be present.

of Turnip, Rape, Mustard, or other allied plants. Rape is noted by one Continental observer, especially, as being attacked, the beetles gnawing the buds and flowers, and the maggots feeding on the seed in the pod, so long as it is not ripe. Consequently on this a kind of premature ripening takes place, and the infested pods are stated commonly to open earlier than those which are uninjured. The full-grown maggots under these circumstances fall to the ground. In the experiments noted by John Curtis, they buried themselves two to three inches below the surface, and enclosed themselves in brown oval cocoons formed of earth.

The maggots are of the shape figured at p. 96, fleshy, legless, transversely wrinkled, yellowish white in colour, with pale brown head. The pupa is of a dull ochreous colour, with black eyes. These descriptions give the appearance when much magnified, but without the help of a glass they are much too small for the characteristics to show clearly.

The duration of the pupal state is of three or four weeks in summer; so where circumstances are favourable, and food-plants at hand, there may be two broods during the season, and the weevils which hybernate in the latter part of the year, supply the parents for the first brood of the following season.

The above slight sketch of the history of the Seed Weevil is taken mainly from the works quoted below, as I have never had an opportunity of observing the attack throughout its course personally.*

MELIGETHES ÆNEUS.

Beetle and maggot, magnified, and infested flower, after Dr. Taschenberg; jaws and antennæ of maggot, much magnified.—ED.

The following notes on the life-history of the "Flower Beetle" are taken almost entirely from my own observations, extending over several weeks in the summer of 1872. †

* 'Farm Insects,' by John Curtis, p. 105; 'Praktische Insekten-Kunde,' by Dr. E. L. Taschenberg, Pt. ii., p. 106; and 'Tierische Schadlinge und Nutzlinge,' by Dr. J. Ritzema Bos, p. 317.

† These observations were undertaken at the request of the late Andrew Murray, F.L.S., Curator of the South Kensington Collection of Economic Entomology, relatively to some (possible) variations in characteristics of broods of different

My observations began on the 22nd of May, and were carried on at Sedbury Park in West Gloucestershire, my then home. The attacks were watched on Turnip, Rape, and Cabbage blossom, but mainly on the two former. The *Meligethes* observed were the *M. æneus*, and the *M. viridescens*. Presumably the *æneus* was present far more numerously than the *viridescens;* but in the out-of-doors part of my observations, where hundreds of the beetles passed under review, it was impossible to distinguish between these very similarly coloured and sized beetles by examination of structure of the shank of the fore-leg; therefore for security I describe them now (as in my original paper) as "Green Meligethes," though probably *almost all æneus*.

This species is one-twelfth of an inch, or rather more, in length, of the shape figured at p. 97; variable in colour, brassy green, or violet, or sometimes with a bluish tinge; legs red with pitchy thighs. The *M. viridescens* is about the same shape and size, the colour green or bluish green, or blue-black above, with reddish legs. The only absolutely sure point of distinction appears to be that the anterior tibiæ (*i. e.*, shank of the fore-legs) are slightly serrated along the outside in *æneus*, and are not so in *viridescens*.

About the 6th of June, I found the "Green Meligethes" or "Flower Beetles" in great numbers on flowers of the Cabbage kind, then apparently feeding only on the pollen, which they collected in any way that might chance,—either from the anthers or from where it had fallen on the flower, or on each other's backs, or by drawing their shanks with pollen attached through their jaws. At this date I found eggs were formed within the beetles, and shortly after both eggs and maggots were noticeable.

The eggs I observed were long, cylindrical, and blunt at each end, and so transparent that the development of the maggot might be watched within from the day after laying. Hatching took place in four or five days.* The maggots, in the early stage, were whitish, the dark head furnished with a pair of sharply pointed, much-curved jaws. The first three segments each bore a pair of claw-feet, and the proleg at the caudal extremity was made great use of in progression.

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species. These necessitated careful notice of the insect, and record of habits from egg-laying up to perfect development, and the main points of the observation are given in two papers (with figures of larval development within the egg, also by myself) published in the 'Entomologist's Monthly Magazine,' numbers for July and August, 1874.

* A clear and full account of the life-history of the *Meligethes æneus* is given by Dr. Taschenberg in his 'Praktische Insekten-Kunde, pt. ii, pp. 12—14; in this he names eight to fourteen days as the time of hatching. My own observations were taken in a sunny garden with warm exposures, or from specimens brought under artificial circumstances which might accelerate development.

The head was purple or dark, with a shield-shaped marking pointing towards the top, and the segments immediately behind the head, with two patches reaching nearly to the middle of the back; the succeeding segments with one spot on each side, the three preceding the tail with an additional spot in the centre, and the last segment with the three spots confluent; each segment was furnished with a bristle on each side, excepting that next the head, which was furnished with two or more. When full grown the larva was whitish.

The method of life, as I observed it on various plants of the Cabbage kind, was as follows:—About the 6th of June *Meligethes* were to be found in great numbers in the blossoms, apparently feeding entirely on the pollen (probably they had been about for some weeks previously); shortly afterwards eggs and maggots were noticeable. The eggs were laid within the unopened buds, and the maggots were to be found in profusion by the 17th of June in the buds and partially opened flowers, which were distinguishable by their stunted and shrivelled appearance. The maggots appeared to prefer feeding at the base of the blossom; presently they spread from the flowers, and might be found in parties of a dozen or two at the base of the stalks of the topmost flowers; others distributed themselves variously, but chiefly on the seed-pods, where the gnawing motion of their brown jaws might be clearly seen against the light colour of the vegetation. Some of these maggots, which I had under observation, left the sprays on the 17th of June (by falling down), and then buried themselves as quickly as they could. About ten days later, I found the chrysalis already formed in an earthen cell, about three and a half inches below the surface of the ground. Probably in natural circumstances, and the hard ground of a field, the maggots would not go so deep.

I had not opportunity of observing the period which elapsed before development of the beetles, and therefore complete the history from the observations of Dr. Taschenberg, referred to above. The earlier date of pupation is probably owing to the differences of Continental climate, and it will also be noticed that he mentions the change to chrysalis taking place in a lightly-spun web, which I did not notice myself, but might possibly have overlooked within the earth cell. Dr. Taschenberg notes:—"At the beginning of June they (the larvæ) are mostly fully grown; they let themselves fall to the ground, and in ten days turn, a little below the surface, within a lightly-spun web to the pupal state, from which the beetles make their appearance in from twelve to fourteen days. These may be found throughout the summer on all the neighbouring blossoms so long as weather permits, and then creep down into the ground for the winter." *

* 'Praktische Inseken-Kunde,' by Dr. E. L. Taschenberg, pt. ii., p. 11.

These beetles are also one of the regular pests of Mustard when it is "knotting" up for flower. In 1886, when circulars were issued by the Royal Agricultural Society requesting information as to the habits of the "Mustard Beetle" (*Phædon betulæ*), and means of prevention of its ravages,* specimens of the *Meligethes æneus* were sent me taken from Mustard at various localities, at dates from June 10th to July 27th; and I had the opportunity of myself examining the attack in the fields at Coldham Hall, and Stagsholt, near Wisbech, during July. It appeared then to be nearly or wholly impossible to do anything by way of remedy to the attack on the growing Mustard. Whether now, by means of the Strawsonizer, anything could be done to clear the attack remains to be seen; but the following detailed observations, with which I was favoured by Mr. John Moss, of Feering, Kelvedon, Essex, and by Mr. Geo. Malden, of Cardington, Beds, show that in the case of the "Flower," and also of the "Seed" beetle attack to Turnips being grown for seed, great benefit may be derived by cutting back the flowering shoots so as to prevent the great swarms of the beetles, which first appear, making good their position, and thus give rise to the legions of maggots which, in their various ways, ruin the hopes of the seed crop. These notes also give some very useful observations on the habits of the insects, and notably, first of all, the vast numbers in which they appeared a little before the 18th of May.

The first communication on the above subject was sent me on the 13th of May from Feering, Kelvedon, Essex, by Mr. John Moss, accompanied by specimens of the small dark greenish Flower Beetle, the *Meligethes æneus*, and the *Ceutorhynchus assimilis*, sometimes known as the Turnip-seed Weevil, which is easily distinguishable from the other kind by its ashy grey colour, and its long proboscis. Mr. Moss wrote as follows:—

"You will find enclosed a quantity of small beetles, clouds of which have arrived during the last week with the dry east wind we have had; the Turnip and Swede seed especially are simply swarming with them. The beetles crowd into the blossoms, and I believe lay eggs, which develop into tiny maggots in the seed pod in June, and cause what are generally called "bladdered" pods; these pods fly open about a fortnight before the good seed is ready to cut, and of course the seed from these pods (which is generally thin and blighted seed) is lost. I estimate that frequently the loss from these tiny maggots is £5 per acre.

"We are seed growers, and you will readily understand that in

* See 'Journal of Royal Agricultural Society,' vol. xxiii., p. 273; also my own '10th Annual Report on Injurious Insects.'

farming about a thousand acres there is often serious loss from various pests. If you are able to suggest any remedy for this present pest I shall be very glad. I have been using the arsenical solution you recommend, and also paraffin with the Strawsonizer; but as the beetles do not appear to be *feeding* it does not kill them, and they *fly* to other crops, and in a few days are as numerous as ever on the crop treated."

Removal of tops and early blooms from the Turnips and results.—On the 18th of May, Mr. Moss wrote further:—"The remedy I have been trying the last few days has been to have women pick the tops and early blooms of the Turnip and Swede, putting them, with the beetles, into bags, which, when full, are carefully tied and the contents buried or burnt. By this means a great number will certainly be destroyed, and as the attack appears to be an early one I hope that, as I have put nitrate of soda on the crop, the later blooms will branch out and fill up, and I trust be free from the beetles. This rain will greatly assist the lower branches to grow." As the beetles chiefly attacked the top and early blossoms, Mr. Moss hoped for good results.

On the 17th of July, Mr. Moss wrote:—"I think a great deal of good was done by securing the beetles by plucking off the early blossoms containing them, and having these destroyed; but how much was due to this or to the heavy rain and artificial manure I am unable to say, but that which looked almost worthless (and would have been so without help) is now a splendid crop. There are, however, a quantity of bladdered or maggoty pods, for if there was not a second attack of the beetles the attack was very long-continued." And to this Mr. Moss added some observations drawing attention to this removal of the early blossom, and causing the plants to branch out afresh, necessarily causing the crop to be later.

On the 3rd of August, Mr. Moss favoured me with a report *regarding the success of the treatment as shown when the crop was cut*, together with some notes as to the period in the beetle attack at which it seemed most desirable to cut off the shoots.

Mr. Moss wrote to me:—"I am now in a position to speak definitely as to result of the method I adopted to counteract the attack of beetle on the Turnip seed. The men are now cutting the crop, and I am happy to be able to report that it is a very good one, quite equal to what I expected before any attack of the beetles was observable. I think I told you that when on bloom the field (of twelve acres) had quite a dirty sooty appearance instead of being bright yellow, and the crop looked worthless; but by securing and destroying the beetles and damaged blossoms, which did not cost more than 5s. per acre, and heavy dressing of manure, which fortunately was followed by heavy rain, a new growth was encouraged and a heavy crop secured, which

comes in about three weeks later than might otherwise have been the case.

"I would recommend that there should be no hurry in adopting this remedy, especially if the attack is a serious one. I think it would be better to be a few days late, and so secure, if possible, nearly all the beetles, rather than commence too soon and perhaps have a second edition on the new blossoms. This remedy appears to be a *certain* one as far as destruction of beetles is concerned; the one other important thing is to try and arrange for it to be done just before rain."

On the 14th of May, Mr. Geo. Malden, of Cardington, Beds, forwarded to me some specimens of Swede-heads, which he noted as being infested with two kinds of insects, which proved on examination (as well as those previously described) to be specimens of the Turnip-seed Weevil, or *Ceutorhynchus assimilis*, and the Turnip Flower Beetle, or *Meligethes æneus*, with possibly some specimens also of another species of *Meligethes*.

Mr. Malden wrote accompanying:—"You will remember that last July I had some correspondence with you in respect of the maggot in the Swede seed-pods, by which an immense amount of harm was caused to the seed crop, and that I forwarded some pods containing maggot for your observation. The damage done then was caused by one or both of these varieties I believe, as every head of seed is just now the feeding ground of one or more of these flies, which are in a most active state, and it is at this period that they are probably doing even more harm than they appear to (bad as that is), by laying eggs near the ovary of the Swede flower, and which becoming enclosed in the seed-pods hatches out, and in the form of the maggot destroys all the seed.

"Undoubtedly, from the severe character of this year's visitation, the whole of the seed (and the crop otherwise has up to now looked extraordinarily well) would be destroyed were the crop in full bloom; and to save as much as we can we have been topping all the shoots, in order to throw back the flowering period for another ten days or so, hoping by that time the fly will have departed or assumed a less injurious form.

"You will observe that all the earlier blooms are already more or less destroyed, and they are very busy on the latter; they eat their way to the heart long before the bloom opens, and one variety appears to me to be quite as bad as the other."

On the 13th of June, Mr. Malden favoured me with the following communication, mentioning that he would have written sooner regarding the Turnip-blossom Beetle and Weevil, but waited to see what course these destructive little pests would pursue in the face of

the cold rains and winds, and even severe night frosts of the latter half of May.

Mr. Malden observed:—"Though their number seemed greatly decreased, there still remained sufficient to do great damage, to what extent will not be known till the seed ripens.

"They appear to a great extent to have concentrated themselves on an eight-acre field of Swedes, a variety whose bulbs are said to analyse out exceptionally rich in sugar, and doubtless the stems are also sweeter than of most other varieties. The Tankard Turnip-seed, and some stronger Swede-seed, are almost entirely free from these ravages.

"As the Swede is not yet in full bloom, owing to it having been retarded by topping, we hope the insects will before then have assumed a less destructive stage of their life-history, and that the later blooms may escape; very few of the earlier blooms have set at all, and probably the few that have set will burst later on.

"Probably a dresssing such as you describe would be highly beneficial; but of course until such a remedy is tried and proved, there is a danger in experimenting on a large scale; and there is an awkwardness in trying on a small scale, as, as soon as the bitter flavour was washed off the plot dressed, all the insects in the immediate neighbourhood, or on other parts of the field, would be ready to return, and the value of the experiment could not be accurately gauged."

On the 21st of July, Mr. Malden added the following further observations regarding a form of sprayer which he considered adapted for service, and also some amount of estimate of loss:—"'L'Eclair' sprayer,* used by Mr. Riley for the potatoes, appears admirably adapted for use in the Swede-seed crops against fly attacks, and we should certainly use it next year if they attack us in such force as this season, if you then recommend any liquid for spraying; if you do not recommend any liquid dressing, we should broadcast the 'Fisher Hobb's' mixture you advised. The Swede-seed is now ripening, and will be fit for cutting next week. The piece originally the best, but by far the worst attacked, will not yield above eight bushels per acre; another piece very slightly attacked should yield twenty-five bushels.

"The last blooms on the stems went off about a fortnight ago, and to the last the fly of both the Seed Weevil and Beetle were present, though in considerably reduced numbers, and by that time the proportionately few pods that had set, though attacked, were blistered by the maggot that had hatched inside."

* This form of sprayer, often known with us as the "knapsack" sprayer without any other special name, has been very generally approved of during the past, as being easily portable on a man's back; it can be used where no wheeled machine could be introduced. For price, address of importers, &c., see p. 76.

To the above observations, Mr. Malden added the important remark, in confirmation of serviceableness of the treatment mentioned, namely, that "our neighbours, who topped the seed last year when we left ours alone, I know had considerably larger yield, and much less fly."

To the above observations, Mr. Malden kindly added the following, at my request, regarding effects of topping:—

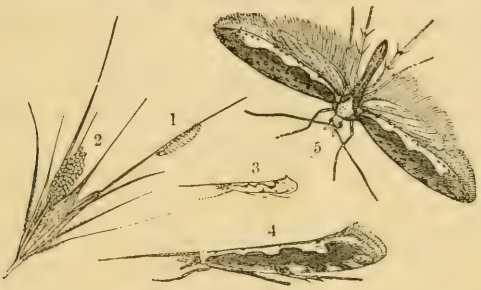
Dec. 19th.—"*In connection with topping Swede-seed*, it is a very general practice among growers, who expect thereby to obtain a large yield of seed, as it throws the crop back quite a fortnight in maturing, and thus gives the rootlets an increased time for action, and many more branches are thrown out, and the whole crop is much thickened on the ground. Independently of this, however, it is much to be recommended as a possible means of thwarting the attacks of fly, where the attack has set in early on an untopped field of seed, as thereby the flowering period is delayed for two or three weeks, and by that time the attack from some cause or other may have passed by, though this is not invariably the case. For instance, in 1890, having a very large acreage of Peas that would employ much hand labour about the time we should, in the ordinary course, be rolling topped Swede-seed, we decided to leave the crops alone, so that the harvesting of that crop should be finished before the time for hooking Peas. In that we were successful, but at the expense of the yield of the Swede-seed, for we had a considerable quantity of fly, whilst our neighbours who topped their seed almost entirely escaped; and where our crops yielded from ten to eighteen bushels, they obtained twenty to twenty-three bushels. But in 1891 topping was useless, as the fly remained from the earliest to the latest period of flowering.

"N.B.—The attack of fly was extraordinarily severe this year. One field we grew, estimated by competent observers to yield thirty bushels per acre, finally came out at four bushels. A neighbour's crop was looking exceptionally well at the early blooming period, in fact no better piece was ever seen, and the yield was put at thirty-five to forty bushels: this came out at fifteen bushels. Two other fields belonging to us were estimated at twenty-five and thirty, respectively yielded ten and seventeen. A like result was experienced by all growers in this district, the Turnips being attacked almost as severely as the Swedes."—(G. M.)

From various notes or suggestions given above, it appears very possible that by means of some of the different implements for distribution of insecticides, or by special alterations to adapt them for use on this kind of crop, fluid or powder dressings may be so applied as to be of service. As yet, however, this has to be made out, and the successive date of opening of the blossoms, from the lowest part to the

top of the flowering shoots, would throw a difficulty in the way of the use of the fluid applications. It will be noted (p. 104) that retarding date of flowering, and also the alteration in growth caused by topping back shoots, are considered by growers to be beneficial; and this seems really to be the only practicable method recorded of saving the seed on the scale of the great infestations almost sure to coincide with great breadths of growth of food-plant.

Diamond-back Moth. *Plutella cruciferarum*, Zeller.



PLUTELLA CRUCIFERARUM.

1, caterpillar; 2, eggs; 3, Diamond-back Moth (all natural size); 4, 5, Diamond-back Moth, at rest and flying (magnified).

The most remarkable crop attack of the past season has been that of the caterpillars of the Diamond-back Moth. These were first reported to me at the beginning of July as then causing serious damage at a locality on the Yorkshire coast; and about a fortnight later, that is, on the 17th and on the 20th of the same month, the first observations of severe injury in Scotland were reported respectively from localities near the coast in Forfar and in Fife. After this, reports and enquiries, with specimens accompanying, followed each other in rapid succession, until the presence of the caterpillar pest, and its ravages on Turnip and Swede leafage, was proved to be established more or less in every one of the counties of our eastern seaboard, from Dover in Kent up to Aberdeenshire in Scotland, with one observation of presence at the almost extreme westerly locality of Fishguard, Pembrokeshire, South Wales. Other observations of attack followed during the earlier weeks of August, until the area of recorded attack was extended to various other scattered localities in England (in almost all cases in seaboard counties), and to some further localities on the West of Scotland, mainly the Isles of Islay and Jura; and on the 14th of August the appearance of the caterpillars was announced as having been observed in Ireland, mainly along the eastern coast.

During the course of the devastation, I was requested by Mr. Ernest Clarke, Secretary of the Royal Agricultural Society of England, to prepare a paper on the subject for publication in the next part of the Journal of the Society, and I beg to acknowledge, with thanks, that much of the information given in the following report is republished, by kind permission of the Council of the Royal Agricultural Society of England, from the above paper prepared by myself, for which see pp. 596—630 of pt. iii., vol. 2nd of the third series of the Journal of the Society.

Whilst the attack was still in progress, or its first effects still very noticeable, our great object was—by collation of the information contributed by observers—to make out as soon as possible how far this trouble might be influenced by any practicable treatment, and especially whether any remedies could at once be brought to bear; and therefore, for convenience of immediate reference, I divided and classified the information, given in reply to my circular of enquiry, under various headings. Now, however, we appear to have gained a very fair knowledge of the attack in all its bearings; and therefore, in re-arranging the reports placed in my hands once again for publication, I give each observer's notes together. Thus (where the returns are full) we have (with locality and date) an account of the first outbreak, and general estimate of mischief then going forward; 2ndly, special observations in reply to enquiries in circular; and 3rdly (in some cases), reports of extent of loss estimated from total destruction of crop, or from deficient bulbing of Turnips and Swedes, consequently on retarded growth from loss of leafage by caterpillar ravage, bringing some of the observations up to the latter part of December. Thus the effect of local soil, and treatment and local weather, and geographical position, can be traced and collated in their bearing on ravage, or escape from ravage, of the caterpillars.

In the following paper I have given, *firstly*, an account of the Diamond-back Moth, the *Plutella cruciferarum*, in its different stages; *secondly*, the reports contributed by observers of the attack of 1891, these being arranged, so far as is possible, under the heads of the respective counties reported from in England and Scotland, beginning in each case with the first observations of outbreak (the few Irish returns being appended); and *thirdly*, the notes bearing on observation of appearance of Diamond-back Moths at various places on the coast shortly before attack of the caterpillars.

To these returns a summary is added, in which I have endeavoured to work out some of the chief points of information contributed into a form for practical use; but for those who are inclined to work out the details of several of the longer returns, there is a great deal of useful practical suggestion well worth study; and I beg to offer my

best thanks to all my contributors for the prompt care and courtesy with which they were good enough to reply to my requests for information.

Life-history and Habits of the Diamond-back Moth, *Plutella cruciferarum* (of Zeller).

This moth is common and abundant in this country in many places during the summer, but it is rarely that bad attacks of its caterpillars to the Turnip crops have been recorded. One of the first records of really serious ravage appears to be that given by John Curtis, as occurring near Petersfield, Hants, in August, 1837.* The next notice of widespread presence and severe damage does not appear to have taken place until 1851, when it was recorded on the high authority respectively of Prof. J. O. Westwood, and of Mr. Stainton; and since then, until the past summer of 1891, I am not aware of any *large* area being infested in this country by this Turnip-leaf pest.

Local attacks, of which observations were sent me, occurred in 1883 and 1884; † these were for the most part at widely separated localities,—as near Harwich, Essex; King's Lynn, Norfolk; Inverurie, Aberdeenshire, and (in both years) at a few places in Yorkshire; and it was from the benefit that appeared to be derived from the use of the scufflers, and quite certainly from application of nitrate of soda in some of these cases of infestation, that I felt justified in suggesting these measures on the outbreak of the threatened caterpillar devastation of the past season.‡

Diamond-back Moth. — *The size of these moths* is only about, or rather under, two-thirds of an inch in the spread of the wings, and to ordinary observation when at rest they appear as brownish-grey moths, about the size of furniture moths, but long and narrow in shape. When at rest, and the upper wings laid along the back, with the edges meeting, the pale patterns along these edges form diamond-shaped marks, whence the English name "Diamond-back Moth"; if seen sideways, the curved-up extremity of the wings, as shown at 3 and 4 in the figure on page 105, is very striking.

On minute examination it will be found that the front wings are long and narrow; greyish brown, darker towards the centre, but marked with some small brown spots in front; a rather broad whitish or ochreous-grey band runs along the hinder margin, with three

* 'Journal of Royal Agricultural Society,' vol. iii. (first series), p. 71.

† See my 'Report on Injurious Insects' for 1883, p. 72; and for 1884, p. 81.

‡ I have not enumerated occasions where this attack has been mentioned, as matter of reminiscence, as having occurred; for it is no easy matter to discriminate from memory alone between attacks of various kinds of green caterpillars which work by gnawing Turnip leaves.

rounded projections on its front edge; this band is usually spotted with very small dark points, and in some specimens it is considerably obscured by the ground colour on the hinder margin, leaving the three projecting parts alone conspicuous. The hind wings are narrow and pointed at the apex, have a long fringe, and are of a pale ashy grey colour. The body and legs are brownish grey; the head and thorax grey or ochreous grey; antennæ white, with some brown or fuscous rings.

The moths lay their eggs for the most part on the under side of the leafage of their food plants, and we see plainly that this is the usual ravaging ground of the caterpillars; still, they may be present sometimes on other parts of the plants.

The caterpillars, when full grown, are about half an inch long, and peculiar in shape, as they taper slightly towards each extremity; this is a marked characteristic. The colour is usually a delicate green or apple-green, but this is variable; in younger state the larva is often yellowish or greyish, with black head.

When near full growth the head is usually grey or yellowish, marked with small black dots, and the next ring is remarkable for the *absence* of the two dark patches often found in small caterpillars of allied kinds, and instead has a number of very minute black specks. The rest of the segments have a few black dots, each bearing a bristle, but these cannot be made out without the help of a magnifying glass. Each of the first three segments bears a pair of claw-feet, and there are also four pairs of sucker-feet beneath the body, and another pair (which are very noticeable from being set out somewhat obliquely) at the end of the tail extremity. When alarmed, the caterpillar lets itself down by a thread, and swings in the air till it thinks fit to return by the thread to its previous locality.

When full fed, which may be in about four weeks, or possibly less, the caterpillars spin their cocoons for the most part on the under surface of the leafage of their food plants, or on stems, or amongst seeds, &c., in fact in any convenient place on or near their food plant. These cocoons are somewhat variable in appearance; sometimes they are a mere open net-work of white threads, sometimes thicker and of a somewhat boat-shaped form. In the former case the colouring of the chrysalis can be distinctly seen through the net; the characteristic colouring, when mature, is whitish with some black streaks. This was very noticeable in some chrysalids sent me by Mr. Moss, from near Kelvedon, Essex, from which Diamond-back Moths soon after came out. In the early part of their formation the chrysalids may be green or brownish; there appears to be a good deal of variety in this matter, so far as I can judge from the many specimens which passed through my hands during the past season.

The time spent in chrysalis state may vary (as given by various writers); it may occupy from rather over one to about three weeks, but there may certainly be two broods during summer or autumn, and the chrysalids from the last brood of the year remain in this state through the winter.

The food-plants of the Diamond-back caterpillars are, by preference, Turnip, Cabbage, and other cruciferous * plants, including notably what we know in England as "Charlock" (*Sinapis arvensis*, L.), in Scotland as "Runches" or "Skellocks." It also attacks, amongst other weeds, "Jack-by-the-hedge" (*Sisymbrium alliaria*, Scop.), a common hedge- or ditch-side plant of early foliage; also the Hedge Mustard or Flaxweed (*Sisymbrium sophia*, L.).

The insect is widely distributed, and is one of the well-known crop attackers on the Continent of Europe, a fact which probably bears very largely on the sudden appearance of the caterpillars amongst the Turnip crops on our eastern coasts. Notes of the vast flocks of the moths noticed, a few weeks before the first outbursts of attack at various localities on the coasts, with coincident observations (which will be found in the following pages) from entomologists light-house keepers and fishermen, besides agricultural observers, appear to me to leave no opening for doubt that the attack of the past season was wind-borne to our shores, and that, the crops being just in a condition for attack, the results were what we know only too well.

Particulars of Diamond-back Moth Attack in 1891.

On the 8th of August, in compliance with the request of Mr. Clarke (Secretary of the Royal Agricultural Society) that I would prepare a paper on the Diamond-back attack, embodying such amount of infor-

* The specific scientific name appended to that of *Plutella* (namely *cruciferarum*) is a very appropriate one, as it well describes the habits of the caterpillar in mainly feeding on *cruciferous* plants, namely those of the Cabbage kind. The word *Xylostella* appended to *Cerostoma*, by which synonym this moth was formerly known, refers to the habit it was, in early days of observation, supposed to have of feeding on the *Lonicera Xylosteum*, L., the upright or two-flowered honeysuckle, a shrub to be found in thickets, and more especially in Sussex.

Here, however, it seems to me that there may have been some confusion of species. As the case stands at the present day, the *Cerostoma Xylostella* of Stainton's 'Tineina,' p. 70, is distinguishable by several clear characteristics from *Plutella cruciferarum*.

The moth of *C. Xylostella*, besides being rather broadly yellowish-white along the hinder margin of the upper wings, "has an extremely narrow oblique white streak running half *across* the wing beyond the middle." Also, the caterpillars are green, *with a broad red stripe on the back*, and are tapering to the *head* end, and make a *firm* cocoon.

During my own investigations, I found a very few green caterpillars striped with brown or reddish brown, which may possibly have been of this kind.

mation as might be placed in my hands, I arranged the following short circular, and forwarded it to my correspondents requesting their assistance by replies to any of the points specified :—

"1.—*Any estimate of amount* of loss, whether in acreage, mileage, or money loss, on crop.

"2.—*Any measures found to answer in lessening amount of ravage or loss from its effects;* as, for instance, effect of fertilizers, as nitrate of soda, superphosphate, soot, lime, &c., given as dressings to push on crop; or any dry or fluid dressings applied to the leaves to clear the grubs, and how applied, as by Strawsonizer, Knapsack Sprayer, &c.; also effects of any mechanical measures, as taking horse-hoes, or scufflers with boughs on them, through the crops; or use of 'sheep driving.'

"3.—Opinion asked as to benefit of heavy rains.

"4.—*Nature of land*—also how cultivated (especially whether autumn cultivated and whether ploughed deeply)—what manure was used, and was salt used.

"5.—*Was weather* observably wet or dry in previous autumn, so as to cause difficulty in cleaning the land, and was any particular weed unusually noticeable.

"6.—Is this caterpillar found to especially *frequent Charlock?*

"7.—*What kind of birds* are especially useful in clearing the caterpillars."

In the following notes I have arranged, in sequence (and with due acknowledgment to the contributors), the observations sent me of first outbreak of ravage of the caterpillars; the replies sent to the inquiries in the above circular; and some amount of information as to direct loss, or estimate of extent of deficiency of crop, which were forwarded later in the year. These observations are given, as far as possible, in the words of the contributors, with date and locality, and name of writer. They are arranged under the main headings of England and Scotland (with some small amount of observation of the presence of the infestation in Ireland); and, so far as is practicable, are further arranged under headings of counties, beginning in each country with the first observation forwarded. In England this was sent from Long Whins, Hunmanby, Yorkshire, a locality near the sea-coast, about eight miles S.S.E. of Scarborough.

ENGLAND.

Yorkshire.—*Long Whins, Hunmanby,* July 2nd. From Mr. Robt. W. Smith. — The specimens of caterpillars sent accompanying varied in size from about a quarter to fully grown, and were of various tints, from yellowish to apple-green. The Turnip leaves were much eaten from the under side, so as often to leave mere patches of the upper

cuticle of the leaf remaining, and often they were eaten completely through.—Ed.

Mr. Robt. W. Smith wrote:—"Herewith I send you leaves of Turnip, with specimens of caterpillar, which has on some farms in the neighbourhood entirely destroyed the Turnip crop, and is fast destroying it on my own."

Replies to inquiries in circular (see p. 110), August 10th:—

(1). "I have had no root-crop quite destroyed, but the estimated produce per acre of Kohl Rabi has been lessened 75 per cent., Swedes and white Turnips 50 per cent., and yellow Turnips 25 per cent. Loss, £60.

(2). "I tried 5 cwt. of dissolved bones per acre, put on each plant by hand, without effect. Before applying the bones I had tried sulphur and lime (after scuffler with boughs on), fumigation with sulphur, Paris-green mixed with water, and Little's non-poisonous sheep-dip; all likewise without effect.

(3). "I think that heavy rains do good by 'soiling' the under side of the Turnip leaf, and making it rather difficult for the caterpillar to work; also by alarming them, or washing them off.

(4). "Clay-loam. Not autumn cultivated. Ploughed deeply in autumn and twice in the spring. Half of Kohl Rabi was farmyard-manured, but no difference is to be seen between the manured and unmanured parts. Dissolved bones and half-inch bones were drilled with Kohl Rabi and Turnips. No salt was used.

(5). "The first half of the autumn was dry (very), and the latter half was very wet. No particular weed was unusually noticeable.

(6). "No Charlock in neighbourhood.

(7). "I think the Starling. Infested crops have been much frequented by Rooks."—R. W. S.

Spikers Hill, West Ayton, Yorks., July 21st. From Mr. John P. Darrell, for Mr. T. Darrell.—"Enclosed I send you specimens of caterpillars, which are eating up all Turnips and Swedes in this locality. . . . At present the brutes are eating all in front of them."

Lebberston, near Filey, Yorks., July 24th. From Mr. John P. Darrell, with specimens accompanying.—"I find, since I wrote to you the other day, the caterpillars have somewhat abated; we have had some nice showers, and it seems to strengthen the plants."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The caterpillar pest is about over in this district, and not before time, as they have completely ruined the Swede crop; there will only be a half-crop. I find Turnips have not suffered nearly as much, and look fairly blooming.

(2). "The method I found to answer best, and the least cost, was using a scuffler with thorn boughs attached in front, and set so as to

turn the leaves completely over; by so doing it broke the webs and let the caterpillars down, and the scuffler buried them. I found that to answer better than using quicklime, as some of my neighbours have been doing.

(3). "The heavy rains we had a week ago did an immense amount of good, splashing the soil on to the under side of the leaf, and either drowning or setting them away.

(6 and 7). "I have noticed Charlock, but could never find any caterpillars on; and as for birds, the common House Sparrow has done a lot of good by picking off the grubs."—J. P. D.

Pocklington, Yorks., July 22nd. From Mr. Thomas Brown, with specimens of Turnip and Cauliflower plants, infested by Diamond-back Moth caterpillars, accompanying.—"According to report received, there are scores of acres similarly affected. I am under the impression that the principal cause is the dry weather of the last few days. To-day, here, we have had some nice showers, beneficial in most respects."—T. B.

Great Driffield, Yorks., July 24th. From Mr. G. W. Clark (auctioneer and valuer).—Specimens of caterpillars of Diamond-back Moth received as samples of "the pest that is making havoc of the Turnips."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The loss I could not really estimate; in some localities the Turnip seems nearly worthless, in others half a crop, and the best, where attacked, I should consider will only make two-thirds.

(2). "My son, on a farm of Earl Londesborough's, tried nitrate of soda, with better result by far than his neighbours, who used soot, lime, and other manures.

(4). "I travel through the greatest Turnip district in Yorks. weekly, and observe the ravage of the pest very minutely. I find it to vary very much, affecting the plant more on flinty soil on the wolds than chalk; also on low lands, where there are different kinds of soil in one field,—say, strong, gravel, and peat,—affecting the gravel and peat, and leaving Turnips on strong land very little hurt.

(5). "I never saw the land in finer condition for the growth of Turnips; it was all that could be desired.

(7). "I should say any small birds which congregate in large numbers are there for food—the pest really.

Everingham, Yorks., July 25th. From Mr. B. Pippet, Agent for The Lord Herries, with specimens of Diamond-back Moth caterpillars and badly injured Turnip leaves accompanying.—"I enclose you some caterpillars with Turnip leaves. Lord Herries, of Everingham Park, would like to know the species; also the best method of destroying them, as they are ruining whole fields of Turnips about here."

Edenthorpe, Doncaster, Yorks., July 29th. From the Lord Auckland. —"I beg to enclose specimens of a caterpillar which has been devastating the Turnip fields in this neighbourhood. The soil is light sand and gravel.

July 31st. "I visited one of my Turnip fields this morning, which is infested by the moth, and found large numbers of specimens, including larvæ, pupæ, and imagines, the last form being the most numerous.

Aug. 2nd. "In one field near my house, which is sown half with white Turnips and half with Swedes, the former have suffered very slightly in comparison with the latter, but that may be attributed to their having attained a larger and stronger growth. In some places the Swedes appear to be entirely destroyed."

Replies to inquiries in circular (see p. 110), sent on Aug. 15th by Mr. Robert Cock, for Lord Auckland:—

(1). "Loss on Swede-turnip crop about one-third. The White Green Top and Lincolnshire Red Turnips have not been affected by the moth.

(2). "The best mixture we used was 10 cwt. soot, 8 cwt. nitrate of soda, with 1 cwt. sulphate of ammonia, mixed well and sown broadcast by hand whilst the *dew* was on the leaves; 1 cwt. per acre. We also used scufflers with boughs on them through the crops; also we tried quicklime, gas-lime, soot in equal parts, 1 cwt. per acre, with 3 lbs. yellow flowers of sulphur added per acre; but the first mixture proved best in checking the spread of moth.

(3). "The heavy rains have been very beneficial, especially where the nitrate of soda mixture was used.

(4). "Land sandy. Autumn cultivated. We clean the land after Wheat, plough deep three times by crossing, then ridge farmyard manure 12 to 14 cart-loads per acre, with no artificial manure, or 6 cart-loads farmyard manure with 3 cwt. dissolved bones per acre, or the same quantity farmyard manure and 4 cwt. concentrated manure per acre.

(5). "The weather was very dry the previous autumn, and the land in this district was especially well cleaned; no particular weed was unusually noticeable.

(6). "No, we cannot find it so; but the Charlock is not abundant in this district.

(7). "The Rook and the Plover.

Lincolnshire.—*Holbeach Marsh*, July 17th. From Mr. William H. West (with specimens of leaves much injured by the green, somewhat spindle-shaped caterpillars of the Diamond-back Moth. The caterpillars for the most part very nearly full-grown, Ed.).—"I am sending

you by this post some specimens of a caterpillar or grub which is making terrible havoc with the Swede-turnip in this district, and which has hitherto been unknown to us. It seemed to appear all at once on Monday last, and has attacked all crops alike, whether they had been affected by the ordinary Turnip Fly or not, and is likely to be most disastrous to agriculturists."

On July 20th, Mr. West further noted that the Swede-turnip crop in the district was very generally affected; and also observed:—"I notice several caterpillars on my Turnip leaves (now in cocoons), and am only afraid that with hot weather attack will come out again, and take the late crops of common Turnip and Rape."

On July 29th Mr. West reported:—"Our Turnips on best-farmed lands are outgrowing the caterpillar, although, of course, they have made sad havoc, and they will only be good *half-crops;* but on weak lands, where there is want of steam underneath the plant, they cut a sorry figure, and many have been ploughed up."

Replies to inquiries in circular (see p. 110), August 12th:—

(1). "I consider that 25 per cent. of the Swede crop in this district in acreage is entirely lost or gone, and that 25 per cent. of the whole crop is so injured as to be valueless; consequently our crop is but 50 per cent. of what it should be.*

(2). "I am of opinion that no application of fluid dressings has been of the slightest service. Nitrate of soda, or fertilisers, may have been, and where the land is in the best heart or condition, the loss will be least; continual scuffling, or in any way brushing the land about, has been beneficial by the assistance and encouragement it rendered to birds.

(3). "To the heavy rains and cooler temperature must be attributed the salvation of the crop.

(4). "The soil is loam of an easily workable nature; it is cultivated on the most improved principles, with autumn ploughing, manured in winter with well-made own yard dung deeply ploughed in, the land then well-worked up and mixed in spring, and the best artificial manure we can procure drilled with the seed about the first week in June.

(5). "The autumn and winter were dry; have never known a winter with less water in the ditches. No weed noticeable.

(6). "Charlock is a weed almost unknown here, but I have heard of a piece of land in a neglected state which has some on, and which

* "In supplementing my reply to question 1, I may add that we cannot form any opinion as to the actual money loss on the crop, as this district is almost entirely devoted to *feeding* flocks, and that consequently so much depends upon the rise or fall in the value of stock, which may nevertheless be somewhat affected by the injury to the Swede crop, as to which way we cannot yet tell."

is entirely stripped by the caterpillars, and they are evidently fond of Brown Mustard.

(7). "Starlings have frequented."—W. H. W.

Sunderlandwick, Driffield, Yorks., July 26th. From Mr. Frederick Reynard, with very numerous specimens of caterpillars of Diamond-back Moths, of different sizes up to nearly full growth, and request for particulars.—"About the accompanying specimens of caterpillars I am sending you, they have been troubling me for the last fortnight; they attack the earlier-sown Swede-turnips only; they are now considerably less in numbers than they were a week ago. I have invariably found them on the under side of the leaf."

Replies to inquiries in circular (see p. 110), August 20th:—

(1). "Damage slight; at present impossible to estimate.

(2). "Damage was done and caterpillars had disappeared before it was known what they were; hence no measures were taken to destroy them.

(3). "Rain appeared to stop the ravages when accompanied by wind.

(4). "Clay-loam; previous crop Oats, deep ploughed in autumn shortly after harvest, cross-ploughed end of January, and twice afterwards; 26 per cent. superphosphate only used; no salt or farmyard dung.

(5). "Weather favourable; no particular weed noticed.

(6). "Have never noticed this caterpillar before.

(7). "Cannot say, but should judge that Sparrows, Rooks, and Wood Pigeons are no use."—F. R.

Appleby (*North Lincolnshire*), (*Post-town*) *Doncaster*, July 20th. Correspondent writing under the name of "N. Lincs." (name not given by request) forwarded specimens of caterpillars of Diamond-back Moth, and of injured leaves. One of the grubs, just over half an inch long, was lying quiet in slight web, as if about to spin up and change to chrysalis. My correspondent noted:—"My Swedes, and many more in this district, are giving way from multitudes of caterpillars on the under side of the leaf."

Replies to inquiries in circular (see p. 110), August 12th:—

(1). "Swedes damaged greatly here; probable loss of 50 per cent. of resulting food; 5 per cent. of Swede area only totally destroyed; white-fleshed varieties not much damaged here (oolite), but much so on the wolds (chalk).

(2). "In my case nitrate of soda has given vigour to the plant, thus doing good. Friends report boughs on scufflers advantageous.

(3). "Heavy rains (1·73 in. and 2 in.) have done immense good, and caterpillars now gone.

(4). "Oolite and on clay; worse on clay. Autumn cultivated, and ploughed 6 in.; 1 cwt. bone meal, 3 cwt. min. phos.

(5). "Clear.

(6). "Charlock not grown here much.

(7). "Starlings in flocks noted feeding."—"N. Lincs."

On the 18th of August, "N. Lincs." further wrote:—"I again report improvement of the Swede-turnips, but a good crop could not be expected from such shattered plants."

The Sycamores, Alford, Lincolnshire, August 9th. From Mr. J. Eardley Mason.—"Diamond-back Moth larva everywhere, but damage very various in amount, and nothing like what is reported from Northumberland. Some fields have escaped altogether."—J. E. M.

Limber, Ulceby, Lincolnshire, July 25th. From Mr. W. Frankish. The following communication refers to ravages of caterpillars, presumably both of the Diamond-back Moth and of the Turnip Sawfly, as specimens of both kinds were sent me, and it would be difficult to say which of the two kinds is the most destructive.

Mr. Frankish observed:—"The caterpillars are now causing destruction to hundreds of acres of our Turnips; these may in some cases survive the attack, but I fear, if even so, the crop must be much below what it ought to come to in weight per acre. I left mine looking well last Monday to go to the show at Brigg; to-day, on my farm of one hundred acres, I could not recognize them as the same fields. So far as the Turnip plants go, they seem to have attacked those just nicely recovered from the singling operation (hoeing). The only thing I see likely to benefit is to keep the scufflers going, and the men hoeing again after them, to destroy and bury the grubs and caterpillars as much as possible."

Replies to inquiries in circular (see p. 110), August 15th:—

(1). "I have looked round my three fields of Turnips, which were more or less attacked by the caterpillars of one description or the other, but I have no doubt by both,* and find they have by no means recovered their lost ground. The Swedes, fortunately only about eleven acres, are almost worthless, and never can be at the best more than one-third of an average crop; and a crop of common Turnips next to them (33 acres) in the same field cannot be more than half a crop, while two other fields of common Turnips (59 acres) will possibly

* The specimens I sent you from the Brigg show were brought to me there by a neighbour on an adjoining farm, but I have no doubt we all had the two enemies, as the leaves were eaten in different ways,—one almost entirely, except the central stalk, the other leaving all the fibres, like gossamer almost, or coarse network; but it would be impossible for us or any one to separate the damage by different caterpillars.—W. F. (Mr. Frankish well describes the two methods of injury,—the almost total destruction of all the tissues of the leaf by the Sawfly caterpillar, and the damage which, though as bad for all practical purposes, still leaves much of the upper cuticle of the leaf looking, in its transparent perforated state, very much like coarse open muslin or lace.—Ed.)

get to be about two-thirds of a full crop; Turnips sown before and after these fields, about 200 acres, have not been attacked, that is to say, to any serious extent.

(2). "All the remedy I made use of was to keep going all the horse-hoes and scufflers I had all day long. One of my neighbours tried trailing a sheep net across his Turnip field, and then sowing lime, but I do not think his field has recovered more than mine. He also had a net hanging on his large horse-hoe trailing on the plants before the knives; this acted well, but the pests were about over when he tried this.

(3). "The rains have done good in encouraging the growth of the Turnips, as, had it been excessively dry, many more plants must have died.

(4). "Our land is light wold land on chalk, but the attack was just as bad on both sand and clay. Two fields of mine were autumn cultivated, and one was simply ploughed in the usual way. Kanite was used (but no salt otherwise) with bone manure.

(5). "The weather was particularly dry. My land was cultivated by steam power. No particular weed observed.

(7). "Crows have been all over the fields since May. Many Starlings appeared when we had the caterpillars, and I noticed many small birds in the Turnips, chiefly Linnets."—W. F.

Norfolk.—*Kings Lynn*, July 21st. From Mr. Edw. A. Atmore.—"Probably you have heard ere this of the ravages of the little moth, *Plutella cruciferarum* (Zeller), in parts of Norfolk, especially in the north and north-west parts of the county near the sea, this year among Turnip crops. . . . On the 18th of this month I was in fields of Turnips near here, and observed these insects (*P. cruciferarum*) in large numbers. They were present in all stages of devolopment—egg, larvæ of various growth, pupæ and imagines, and already the crops have suffered severely from the attack."

On August 1st, Mr. Edw. Atmore further mentioned:—"The recent, and I may say continued, heavy rains have apparently caused a lull in the attack of this pest on the Turnip crops here, for in many fields I have recently examined I could find very few larvæ, although a day or two previously they had been abundant there. Moreover the rains appear to have much stimulated the growth of the plants."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "Loss from this attack is without doubt very considerable, especially near this coast (north and north-west Norfolk), where both Cabbages and Turnips were attacked. At Thornham, I understand, the Cabbages were attacked first and nearly destroyed on one farm. I

am informed that the loss in acreage amongst the Turnips is about one-sixth of the land sown (one-sixth of about eight acres).

(2). "Soot, and also superphosphate, have been used apparently with good effect.

(3). "All the early-sown Turnips attacked by these caterpillars have been undoubtedly much benefited by sudden and heavy rains. In one field I examined at Thornham, in which the attack was bad, scarcely a living caterpillar could be found after two days' heavy rains. They were very abundant *there* previous to the rain. N.B.—The east sides of fields were far more attacked than other parts.

(4). "At Thornham the soil is fairly good, bright and light, with chalk about two feet below the surface. Land ploughed about three inches—difficult to plough deeper there; no manure used.

(5). "Weather decidedly fine and dry last autumn. Lateness of harvest caused difficulty in cleaning the land. Land not particularly weedy at Thornham.

(6). "The caterpillar of *P. cruciferarum certainly* does frequent *Charlock* here, I think, more so than any other weed, although Hedge Mustard (*Sisymbrium officinale*) is much patronised by it, and Shepherd's Purse (*Capsella bursa-pastoris*) is also used as a pabulum by the larva. I found the moth very abundant *recently* on a weedy strip of a field near Lynn in which *Charlock* was undoubtedly the commonest Cruciferous weed, and showed signs of attention from these larvæ.

(7). "Cannot say that I observed any actually at work devouring these larvæ."—E. A. A.

Horsey, Gt. Yarmouth, E. Norfolk, July 15th. From Mr. C. C. Rising.—"I enclose you herewith some Turnip leaves with small green caterpillars; these attack the leaves from the under side, and take off nearly all the crop." The leaves were much injured both through the leaf, and also so as to leave the skin of the upper side of the leaf remaining, thus giving the muslin-like appearance often characteristic of this attack, which is noted, as is also the beneficial action of heavy rain, in a later communication from Mr. Rising, sent on July 21st:—

"Many of the caterpillars were sent, but evidently made their way out. I will send some more, and would have done so to-day, but the rain and thunder storms are so incessant that it is not easy to collect them. They are a small bright green coloured insect, very active, and appear on the under side of the leaf only, and the leaves, where they have been, present the appearance of fine muslin.

"My tenant brought me the leaves sent in a great state of anxiety, but as he told me he has sown superphosphate and ashes, and the plants were or had been growing fast, I advised him to leave them, as the insects seemed to me to adhere so slightly that I thought a heavy rain would clear off most of them; the past rains have done so, and

the plants have taken advantage of the rest, and will, I think, come again; the very heavy rain now will, I think, cure it. I had never seen it here before; the action was so rapid that two days seemed enough to do the damage."

Replies to inquiries in circular (see p. 110), August :—

(1). "In early-sown Turnips the loss in yield is about 25 per cent.; in later 15 per cent.

(2). "The insects lying very lightly on the leaves, brush harrowing once lightly would remove them, and then Strawsonizing with paraffin would, I think, be thoroughly effectual; but as the action of the caterpillars is very rapid, careful observation and instant action on their appearance is imperative.

(3). "Heavy rain would have the same effect as both the above and has effectually cleaned them here; the plants are mostly recovering.

(4). "Fine alluvial, deep and lightly ploughed in different parts. Superphosphate and salt used

(5). "Weather average. Land cleaned. No particular weed.

(6). "Charlock and Turnips suffered equally, Mangold not at all, in same fields. Have never known them on Charlock before, and we have *plenty*.

(7). "Fowls of sorts followed the hoers and eagerly ate the caterpillars. No birds specially noticed although looked for; last winter killed great numbers of Blackbirds and Thrushes.

"Finally, if no Strawsonizer available, repeating the brush harrowing would, I think, answer equally."—C. C. H.

Oxnead Hall, Norwich, August 8th. From Mr. R. C. Rising.—"My Turnips are very much injured by the Diamond-back Moth, which is so prevalent this year."

The Manor House, Shropham, Thetford, Norfolk, August 7th. From Mr. Fairman J. Mann.—"Fortunately in this immediate neighbourhood we have not suffered much from the Diamond-back Moth; still I think on my own farm the Swedes, and particularly the Thousand-headed Kale, have been attacked slightly. The latter are full of holes in the heads, but I cannot find any caterpillars. We have lately been deluged with rain, which, I hope, may have destroyed these insects."

August 11th. — "Several of my friends in this county have received most severe injuries from this moth, and they, on Saturday at Norwich, informed me that the caterpillars had disappeared. This my friends attributed to the *enormous fall of rain which has recently fallen in Norfolk*."

Bale, Dereham, Norfolk, July 24th. From Mr. John Hammond, M.R.C.V.S. (with specimens of caterpillars and cocoons of Diamond-

back Moths with Swede leaves much injured by attack).—"The leaves, as you will observe, are partly consumed by a kind of canker-worm or caterpillar. Some hundreds, and possibly thousands, of acres are thus affected in this neighbourhood, and almost every Turnip in a field more or less injured, threatening a serious loss to farmers. My own Turnips are grown in a mixed soil, from farmyard manure and superphosphate."

Norfolk and Suffolk.—One of the most important of the first notes of attack of the Diamond-back infestation which I received was sent me on July 18th, with specimens accompanying, by Mr. E. Clarke, Secretary of the Royal Agricultural Society of England, on the part of Mr. Garrett Taylor, Member of Council of R. A. S. E., of Trowse House, Norwich. Mr. Clarke wrote me that he was informed that the caterpillars were making fearful havoc among the Swedes—in fact, a field of thirty acres had been completely eaten away—and I was urgently requested to telegraph to Mr. Taylor at the earliest moment, as there was as much harm being done as if there was a swarm of locusts.

Whitlingham (*Norfolk*) *and Corton* (*north-east of Suffolk*), July 21st. From Mr. Garrett Taylor, Trowse House, Norwich.—"You are quite right in stating that, when the attack does come, it is apt to sweep the whole crop before it, and this is what it has done at Corton, near Lowestoft. We have given a heavy dressing of paraffin with the Strawsonizer and some of the smaller tenants have scuffled the Swede crops with boughs, and having had some very heavy rains we are hoping that the crop will now outgrow the attack, where it has not been so overwhelming as in some parts of Corton."

On the 30th of July, Mr. Garrett Taylor further wrote:—"I am sorry to find that you substantiate the report that the Diamond-back caterpillar attack has broken out on the west coast as well as on the east. . . . I think the best remedy that has yet been found is a mixture of three-quarters soot and one-quarter lime, and sown on the plants. I am glad, however, to say that the top dressing of nitrate of soda and salt that I have given mine, combined with the heavy rains, has already afforded an impetus to the plants; so much so, I think they are growing away from the little pests and will now do, I hope."

Two days later, that is, on August 1st, Mr. Taylor reported further, "that the heavy rains appear to have killed all the caterpillars, and very few cocoons are left on the leaves, but the roots are slow in recovering. One of our tenants at Corton used a scuffler (filled with boughs) on some Swedes which were not hoed out; this answered very well, and the plants are now growing well."

Replies to inquiries in circular (see p. 110), August 18th:—

(1). "So far as Corton and Whitlingham are concerned, taking the Swede crop (which is the only one injured) at £6 per acre as the

maximum value of a full well-grown plant of Swedes in Norfolk and Suffolk at Michaelmas valuation, the greater part of the Corton crop was entirely destroyed, while the remainder (with the exception of one piece, which was sown very early, and appears to have been too forward for the caterpillar to attack) cannot be more than one-third of a full crop under the most favourable circumstances; while the Whitlingham crop being attacked about three weeks later than Corton, the heavy rains coming at the same time washing in a good dressing of nitrate of soda and salt, appears to have at once stopped the ravages of the pest, but not before they had checked the growth of the plants, so that under the most favourable circumstances there cannot be much more than half a crop.

(2). "Nitrate of soda and salt, about four stones per acre of each sown by hand along the drills, were very effective in setting the plants growing; and a scuffler filled with boughs was tried at Corton and answered very well indeed; as also four to six gallons of paraffin per acre applied with the Strawsonizer. We should have tried soot and lime had not the ravages been stopped; should also have walked a flock of lambs backwards and forwards over the plants, which, I believe, would be very beneficial and would act as a scuffler, and would not injure the Turnips.

(3). "Every benefit to be derived from heavy rains—in fact, I much question whether the pest could be entirely destroyed by any artificial means without them.

(4). "The land at Corton is a strongish top soil on yellow clay, and owing to the exceedingly dry weather up to October and frost and snow afterwards, was not ploughed or cultivated until latter end of February or the beginning of March, and then only ploughed fleetly. In some cases the manurings for Swedes were town manure, fish refuse, with a good proportion of salt, mixed up together and put on at the rate of ten loads per acre, while in others 4 cwt. of mineral superphospate and half cwt. of nitrate of soda were applied before the attack. At Whitlingham the surface soil is a good light soil on brick earth, and was cultivated in the autumn, and ploughed a good depth in the spring before putting in the Swedes. Some fields were manured with ten loads of farm manure, and others with 4 cwt. of mineral superphosphate per acre.

(5). "Exceedingly dry up to October, and where stubbles were broken up during harvest or immediately after (before the land got too hard and dry for ploughing), gave farmers a good chance of cleaning the land.

(6). "Have no experience of Charlock.

(7). "Cannot say anything as to what kind of birds are especially useful in clearing away the caterpillars."

Essex.—*Feering, Kelvedon*, August 6th. From Mr. J. W. Moss.—Mr. Moss reported first with regard to absence:—"I am happy to say I have not seen anything of the Diamond-back Moth, perhaps because this is not a Turnip-growing district. We grow Turnip-seed largely, but although we farm twelve hundred acres nearly, we have not an acre of Turnip-roots." He then added:—"I noticed to day on some cress . . . a large quantity of chrysalids, some of which I enclose." These proved on examination to be very characteristic specimens of Diamond-back cocoons, which had been spun on the seed-vessels of the cress plants, and from these very perfect specimens of Diamond-back Moths developed shortly afterwards."

I had also a note, at the end of August, from Mr. Champion B. Russell, of Stubbers, Romford, in which he mentioned having found cocoons and caterpillars (which, by his description and comparison with identified specimens, must have been those of Diamond-back Moth) in a field which *had been* badly attacked by caterpillars. Still, so far as reports to myself show, the great body of attack did not run farther south than Lowestoft.—Ed.

Kent.—*Littleborne, near Dover*, July 31st. From Mr. Montague Kingsford, with specimens accompanying of caterpillars of Diamond-back Moth (for the most part spun up for passing into chrysalis stage), and also specimens of much injured leafage.—"I have found to-day, in a three-acre piece of Brussels Sprouts, that a caterpillar has ravaged the leaves from underneath, and in some cases has almost destroyed the plant. I have gathered some of the leaves with the caterpillars upon them, and have sent them to you to-night."

Replies to inquiries in circular (see p. 110), August 18th:—

(2). "Brussels Sprouts attacked. A part was syringed with a preparation of soft-soap and paraffin, 5 lbs. of the former and 5 pints of the latter, to 100 gallons of water; result, caterpillars destroyed; remainder of plants, soot scattered on the under side of the leaves; result, same as above.

(3). "It is believed, however, that the heavy rains have been chiefly instrumental in clearing the caterpillars.—M. K., per bailiff.

South Wales. — *Pembrokeshire. Treathro, Fishguard.* From Mr. W. Reynolds, with specimens of Diamond-back caterpillars accompanying.—"I beg to send you samples of Turnip leaves affected by some caterpillars; some of the worst part sent. The crop was sown early, and is very forward, but the whole of some three acres affected."—W. R.

Salop.—*Ellerton Grange, Newport*, August 3rd. From Mr. T. H. Ward.—In reference to previous communication regarding caterpillars

affecting the Turnips, Mr. Ward forwarded specimens of Diamond-back caterpillars then ravaging the leaves (of which some were gone into cocoon), and also some of the injured leaves. Mr. Ward remarked:—"I now forward you specimens of green caterpillars ravaging the leaves of Turnip, with leaves damaged by them (is this the Diamond-back Moth?). The Wood Pigeons have been very destructive with the leaves of the Swede-turnip this season; I presume it is through this attack of caterpillars."

Replies to inquiries in circular (see p. 110):—

(2). "Where stimulating manure (nitrate of soda) has been applied, Swedes appear to have more vigour after severe attack has passed away; not tried any spraying.

(3). "Heavy showers undoubtedly have done good.

(4). "Friable loam; farmyard manure ploughed under deep in winter, a dressing of 5 cwt. steamed bones, and 1½ cwt. nitrate applied when Turnips were sown; no salt used.

(5). "Remarkably dry winter and spring; no particular weed."—T. H. W.

Cheshire.—*Bradwall Reformatory, Sandbach*, August 15th. From Mr. S. Suffield.

Replies to inquiries in circular (see p. 110):—

(1). "Estimate of loss per acre, £10.

(2). "Nitrate of soda at the rate of 2 cwt. per acre as a top dressing, to push forward the growth of plants, is, I believe, very beneficial; it acted well for our Turnips.

(3). "Very heavy thunder showers might shake the leaves, and cause the caterpillars to fall to the ground; but I believe a good strong wind would disturb the plants a great deal more.

(4). "Nature of land heavy, strong soil; spade and fork culture nearly throughout August in the autumn to the depth of 8 or 9 in.; gave part a light dressing and part a heavier dressing of gas-lime (the heavy dressing would be at the rate of 3 tons per acre, and the light one 1½ tons per acre) about the 19th of December; allowed it to remain on the top until March; and where the heavier dressing was put *very little* destruction was done by the caterpillar. Good litter manure was used at the rate of 12 tons per acre, also a specially prepared artificial manure of 5 cwt. per acre; 1 cwt. of salt per acre was part of the artificial manure.

(5). "Wet weather in previous autumn; the land free from weeds.

(6, 7). "Cannot say."—S. S.

Lancashire.—*Estate Office, Lytham*, August 10th. From Mr. Thos. Fair.—"I am forwarding to you two small caterpillars" (of Diamond-

back Moth, Ed.), "and some Turnip leaves. The crop from which they were taken has been very much damaged, and I shall be glad to know of any remedy or prevention."

Replies to inquiries in circular (see p. 110), August 13th :—

(1). "Three statute acres have been rendered quite useless.

(3). "The leaves up till about ten days ago had been eaten quite bare, but after the heavy rain showers of last week they grew again.

(4). "The land is strong black land, with a subsoil of white ore ; it was ploughed in the autumn to a depth of about 9 in. ; the field had a light dressing of ordinary farmyard manure, and one acre had 2½ cwt. of dissolved bones. The weather was wet in November, but subsequently very dry.

(7). "A great number of Sea Gulls have frequented the field, and also a few Grey Plovers.

"I have noticed, on the east coast of Yorkshire, that Turnips seem to be similarly affected to a considerable extent."

Oct. 6th. "The field about which I wrote to you in August has, I am glad to say, worked out fairly satisfactorily, though there are patches in it where the crop has been quite destroyed. I attribute its improvement to the heavy rains we had in August, which destroyed the caterpillars."—T. F.

Durham.—*Parklands, Castle Eden*, July 24th. From Mr. Rowland Burdon, with specimens of Diamond-back Moths and caterpillars accompanying. — "I am sending to you to-day a box containing (1), Swede-turnip leaves covered with green caterpillar ; (2), smaller box containing four specimens of a moth. I have a field of Swede-turnips close to the sea—some 12 acres—almost every leaf of which is covered with these caterpillars, and in the same state as the enclosed specimens ; and, as there are quantities of these small moths flying about, I fancy they are the source of the mischief. The attack only commenced a week ago. We had dry weather till St. Swithin, and every day till yesterday since then has been wet, more or less. The Swedes would be meeting in the rows in a fortnight, but now look as if the whole field would be spoilt. . . . Another field about half a mile off is looking very well. The caterpillars are almost invariably on the low side of the leaf ; so that a Strawsonizer, even if I had one, would hardly reach them."

On Oct. 6th, Mr. Burdon further wrote me regarding the then state of the attacked crops :—"As to the attack on my own fields, my bailiff applied soot, pure and simple, and I was very much assisted by quantities of small birds, chiefly Starlings and Finches. I could not at this moment tell that the fields had ever been attacked. The Swedes are distinctly a good crop ; if anything the 12 acres that

suffered most is the best of the lot. I do notice, however, that my Swedes have been more to leaf than usual. Whether this is due to the weather or the soot, or that Nature has overdone it, so to speak, in recovering from the attack, I cannot say."—R. B.

On application, on the 21st December, to Mr. Rowland Burdon for some further points of information, he favoured me with detailed observations of attack on his farm of Horden Hall (Castle Eden, Co. Durham), drawn up by his farm bailiff, Mr. John Grindley, from which I give below the main points. It will be observed that the attack was markedly noticed, both as to first appearance, and also as to being most injurious on the plants nearest the sea.

Field of 19 acres, of which 16 acres were sown with Swedes on the 8th and 9th of May. A portion of the field badly attacked by Diamond-backs. Soot applied to this portion at the rate of 2 cwt. to the acre on the 7th and 8th of August.

Another field of 24 acres; 14 acres sown with Swedes on the 22nd of May. Attacked severely by Diamond-back. Soot applied August 6th at the rate of 2 cwt. to the acre, sown by hand, one drill at a time, the sower stooping a little, and keeping his hand low at the delivery. The plants at date (August 6th) looking bad; the leaves almost covered by Diamond-backs, perforated; younger shoots withered, sapless, and of a pale brown colour. The remaining portion sown with Aberdeen Yellow Turnip-seeds on 13th to 18th of June, and not affected. After the soot was applied it was not long before the pests appeared to drop from the leaves to the ground, the plants recovering. Three single horse-hoes were put on, doubling the drills as they were done in opposite directions. The observer (Mr. Grindley) especially notes :—"From the close observations and examinations I made, I am thoroughly satisfied that the soot did not kill the Diamond-back, only dislodged it, strengthening and increasing the growth of the plant." He also noted that "this field is situated direct east of the above, and almost adjoining the sea, and was the first where the moth appeared." —J. G.

In the other field reported, three acres were sown with Swedes on the 24th of May, and seven acres with Aberdeen Yellow Turnips on the 10th of June. These were treated with gas-lime, 12 cwt. to the acre, on the 3rd and 4th of August, the plants at this time being perforated, the drill-ends adjoining the sea worst. "The gas-lime did little good to any part; in fact, drill-ends of both kinds of plants adjoining the coast were horse-hoed, redrilled, and sown with Rape. I might also add that the same results followed from a small portion I tried, as an experiment, with quicklime and superphosphate."—J. G.

Enclosing the above (Jan. 6th, 1892), I was favoured by a note from Mr. Burdon, in which he observed:—"I tried nothing, as you

see, but soot and gas-lime separately. The former seems to have succeeded very well, and the latter did little or no good. The Swedes were nearly meeting in the drills when the attack *began*, so whether the results would have been as good if the plants had been more weakly, I do not know; but my Turnip crop is decidedly a successful one this year, quite as good as usual. And the only thing that I can trace to the effects of the moth attack is that the Swedes seem to have been more to *neck*, as well as *leaf*, than usual."

Hartlepool, Co. Durham, Dec. 19th. From Mr. John E. Robson, F.E.S.—"You will be interested to know how the fields of Turnips in this neighbourhood that were so seriously attacked by *Plutella cruciferarum* have turned out in the end. With one exception, I have seen all of them; I mean all those that appeared to suffer much. They have all produced a very excellent crop, many of the Turnips being of large size—extra large, and all of very good quality. . . . One of the farmers, Mr. Collingwood, who had, I think, the worst field of the lot, told me yesterday that, though Turnips were a difficult crop to average, he had seldom had better than this year, and that the two fields which suffered most from the caterpillars were quite as good as any others. . . . I had the impression that the result to be expected was late, small Turnips, and they would be hard or stringy, but that has certainly not been realised here."—J. E. R.

Northumberland.—*Waren House, Belford*, July 24th. From Mr. J. Burdon Sanderson, with specimens of Diamond-back Moths and caterpillars accompanying. After alluding to the specimens (and also a Swede leaf) sent, Mr. Burdon Sanderson continued:—"They are taking the Swedes and Turnips in this country wholesale, some fields being almost left as if no Turnips had ever been there. They are also on some Kohl Rabi and Drumhead Cabbages which I have here. Since the caterpillars first appeared we have had heavy rain, but I regret to say it has not checked them in the least."

Replies to inquiries in circular (see p. 110), August 13th:—

(1). "In some cases in the district round Bamborough the loss is the whole crop gone. I can hardly tell yet what loss I have sustained in my Turnips as I hope they are coming round.

(2). "I applied quicklime by hand on a windy day, as the wind was blowing up the drills; the lime got well under the plants and stuck to the leaves, covering the undersides well. This did not kill the caterpillars at all, but, I think, rather prevented their working, and I hope checked them in spinning their webs or cocoons. I top dressed the worst with nitrate of soda, which stimulated their growth, and thus helped them; but what certainly did the most good was scuffling with light branches fastened across the scuffler, and I consider that the

best treatment was to keep constantly working among the Turnips, scuffling and running the small plough between the drills.

"I saw paraffin oil applied on another farm with the Strawsonizer, which, I believe, did little or no good. A mixture of arsenic and lime, also applied with the Strawsonizer, apparently killed the caterpillar; but I did not see this done myself, so cannot speak positively about it.

(3). "Rain did not kill or even wash off the caterpillars in my case, but as it kept the plants growing to a certain extent, it did good.

(4). "Fine loam. In one field I had rather a good instance of cultivation, as out of the field (which is about eight acres) two acres were not ploughed till just before sowing Swedes (the field had been Oats); the rest was ploughed in winter. The caterpillar was equally bad on both bits where Swedes were sown, but hardly did any harm to a strip of early-sown yellow Turnips between the two lots of Swedes. Manure used farmyard and fish phosphate. The Oat-stubble was ploughed about eight inches deep, and was twice ploughed again before drilling.

(5). "There was nothing in the weather to prevent cleaning the land, which is singularly free from any weed. We had an extraordinary hot dry month in February, which might be favourable towards hatching moths.

(6). "There certainly is a considerable amount of wild Mustard about our land. I did not notice the caterpillar on it, but cannot say I looked carefully.

(7). "Birds did not come much to our Turnips, but I believe Peewits and Starlings are the most useful."

(Observation). "I may mention that yesterday, in examining some Turnips in a field here* (this, forty miles from the sea, is high up on the moors with hardly any arable land at all), we found the caterpillars at work in a pretty newly-hatched stage, so though they have got here they are much later. They seemed to be strongest on the sea-coast, and though they reached farms well inland, they were not nearly so destructive. When I left Waren on Monday the Swedes were looking much better, and were almost entirely free from caterpillars, so I hope the worst is over."

On the 8th of October Mr. Burdon Sanderson, writing from Waren House, Belford, reported:—"I am glad to say my Swedes have recovered from the attack, and, though a bit later, are a capital crop. I quite expected to have had to plough them out."

On December 23rd, in reply to my inquiries as to what the ultimate result of attack proved to be in its effect on size of roots, Mr.

* Written from Otterburn Dene, Otterburn, Northumberland.

Burdon Sanderson was good enough to give me the following detailed account:—

"There is no doubt that where Swedes were badly attacked by the Diamond-backs, the roots are considerably smaller than they otherwise would have been, which, I suppose, is caused by the check in growth that they got at the perhaps most critical time, *i. e.*, a week or two after being singled. Some earlier Swedes in the same field have pulled a first-rate crop of bulbs, but owing to their being almost met in the drill when attached, the insects did practically no harm. Some yellow Turnips, also early sown, turned out well, but the later ones are also small in roots.

"As you say in your letter, the leafage in all these cases was first rate, but when we came to pull them they turned out as above. Of course there were some cases in the neighbourhood where even good strong Swede plants were entirely destroyed, and subsequently ploughed out, but this did not happen to any extent, and where it did it was close to the coast. My land here lies close to a large tidal bay which fills when the tide comes in, but we are some two miles or so from the main sea.

"I may mention that the Kohl Rabi and Drumhead Cabbages have not suffered to any great extent, although partially attacked."

Newcastle-on-Tyne, July 24th. From Messrs. Samuel Finney & Co., seed-merchants, with specimens of Diamond-back caterpillars accompanying.—"We beg to enclose you some specimens of a caterpillar which the last few days has almost entirely eaten up the crops of Turnip and Swedes; it has also attacked Cauliflower and Savoy plants; it seems to extend all along the sea-coast to beyond Berwick-on-Tweed, and to go inland about five miles. The first indication was the appearance of small white-winged insects, the size of the house moth. It is painful to see large sturdy Turnip plants riddled like a sieve, wither and die."

The following short records of appearances of the caterpillar in Northumberland are taken from the number of the 'Alnwick Guardian' for Saturday, August 1st, 1891, by kind permission of the Editor (who also was good enough to furnish me with full names of locality). In this, under the heading of "The Turnip Pest," replies are given from many representative agriculturists of the county of Northumberland to inquiries as to, 1stly, whether the correspondent's Turnips were affected by this pest; 2ndly, whether he believed the destruction of Rooks and small birds has been conducive to the spread of the insect; and 3rdly, what he considers the best remedy.

The paper contains much useful information, especially as placing good practical observations on the subject of this attack, *not* being

attributable to the absence of birds, before those who lean to a view of trouble being arising from this cause; but I have only copied the short sentences bearing on presence of the attack.

These will, I think, be considered to show the great prevalence on the coast, and the note by Capt. Winchester regarding the clouds of moths being brought by the *easterly winds* from the shore; and being seen on the Farne Islands (when the wind was blowing *towards* the shore) is a valuable confirmation of other observations, all pointing to the pests being windborne, and spreading westward on the land.*

The notes are arranged in two series of localities; the first running from Beal southward along or near the coast, the other more inland.

Mr. A. M. Hardy, Ross, Beal.—"One hundred acres nearly all destroyed."

Capt. Winchester, R.N.R., Greenhill, Belford.—"Turnips completely destroyed, some of them three weeks ago."

Mr. James Tait, Estate Office, Belford.—"Swedes and earliest hybrids very badly affected; last sown ones not much and may recover."

Mr. Richard D. Little, North Charlton, Chathill.—"My Turnips are affected with the pest in every field."

Mr. John Craster, J.P., Craster Towers, Lesbury.—"Very much affected, particularly Swedes."

Mr. H. H. Scott, Hipsburn, Lesbury.—"My Turnips are badly affected by the caterpillar."

Mr. John Bolam, Bilton House, Lesbury.—"My Turnips are very slightly affected by the pest; it is scarcely noticeable on them."

Mr. W. Pringle, Branton, Alnwick.—"The caterpillars were first noticed here on Friday, the 24th (of July, Ed.), on two fields of Swedes; so far the whites have not suffered."

Mr. Edw. Forster, Broome Park, Alnwick.—"The pest is on my Turnips, which, however, were well advanced before being attacked, and are as yet holding their own against the enemy."

Mr. T. H. Jobling, Stamford, Alnwick.—"I regret to say my Turnips, especially the Swedes, are affected, the larger ones suffering least."

Mr. Geo. Edw. Coxon, New Bewick, Alnwick.—"So far only slightly affected. Early-sown Turnips seem to have suffered the most."

(Memorandum in Capt. Winchester's report).—* "They are brought here in a cloud by the prevailing easterly winds of our late spring, and I am told they were seen sticking on the light-house windows on the Farne Islands" (this was recorded as occurring on the night preceding July 10th, and the moths were identified as Diamond-backs; see details given further on regarding appearances of vast swarms of moths on the English and Scotch coasts, Ed.) "when the wind was blowing towards the shore. That could show which way they had come."

Mr. Job Tait, Eslington Hill, Alnwick.—"I have examined all my Turnips most carefully, and cannot see any insect upon them."

Mr. L. C. Chrisp, Hawkhill, Alnwick.—"All Turnips more or less affected, yellows especially."

Mr. W. L. Miller, Warkworth (at the mouth of the Coquet, about six and a quarter miles south-east of Alnwick).—"Like my neighbours in this part, my Turnips are affected, the last singled ones suffering the most."

Returning now to the more northerly part of the county, and returning southward by what, as far as I see by map consultation, is n all cases a more inland line, there appears to be a much lesser amount of infestation than at most of the above localities, which chiefly range on or near the coast.—Ed.

Mr. Geo. Grey, J.P., Milfield, Wooler.—"Affected to a certain extent, but I do not anticipate any serious damage."

Mr. Thos. Chartres, Akeld House, Wooler.—"All my Turnips are more or less affected by the caterpillar. The strong robust plants seem to be outliving the attack; the younger and weaker ones will have a hard struggle to pull through."

Mr. Wm. Hindmarsh, Ilderton (about four and a half miles S.S.E. of Wooler).—"My Turnips (Swedes especially) are affected by the pest, but so far the injury, though no doubt it exists, is not apparent."

Mr. J. B. Anderson, West Cottingwood, Morpeth.—"Turnips affected by the pest. Only yesterday morning, the 27th inst. (July, Ed.), I found them. They have attacked the latest sown first."

Mr. Wm. Trotter, S. Acomb, Stocksfield-on-Tyne, Newcastle-on-Tyne.—"Our Turnips here are scarcely affected as yet; it is only by close inspection that any caterpillars are to be found."

Goswick, Beal, R.S.O., Northumberland, July 22nd. From Mr. L. Morley Crossman, on the part of Sir Wm. Crossman. Specimens of Diamond-back attack sent accompanying, with Swede leaves very much injured, in the condition sometimes known as "muslined."—"I beg to enclose leaves of Swedes, which are attacked by some insect. . . . . The land was dunged with farmyard manure, and top-dressed with 2½ cwt. superphosphate and 2½ cwt. vitriolated bones."

(Top-dressing on outbreak of attack given below.—Ed.)

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "The first question I am afraid I cannot answer generally, for accounts seem most conflicting as to loss.

(2). "I top-dressed with small lime first, and then with 1 cwt. of nitrate of soda and 1 cwt. of superphosphate to the acre. I have no hesitation in saying that this latter dressing has been most beneficial. It has given vitality to the plants, without which I think they would have gone off; but fresh leaves have been put out, and since yesterday's

rains (the first of any consequence since the attack), I think that, as far as I am concerned, those plants in which the heart was not injured are safe, and will now come to maturity, though maybe very late. Boughs tied to the scufflers seemed to do good where the attack was bad, and where the plants were fairly full grown.

(4). "The Turnips first attacked with me were sown on heavy clay; the land was ploughed in the autumn very dry, and ploughed again in the spring very deep, and in very dry weather. The land had 20 loads farmyard manure, 2½ cwt. of superphosphate, and 2½ cwt. of vitriolated bones to the acre. No salt was used.

(5). "The weather last autumn, as far as I can remember, was dry, and I noticed no weed in great quantity.

(6). "In one part of the field first attacked was a good deal of Charlock, and at this point the attack began, the Charlock being entirely consumed; but whether this points to the caterpillar being especially found on Charlock, I cannot say.

(7). "Starlings are especially useful in clearing the caterpillars, and I feel convinced that the Rook is also most useful, for this year, especially since this attack, have they been very busy amongst the Turnips. I also notice a great many Peewits and Gulls about."

Branton, Alnwick, Northumberland, August 11th. From Mr. Wm. Pringle. In his letter accompanying the replies to the circular, Mr. Pringle observed:—"I would not have detected the caterpillar so soon on my Turnips if I had not been staying for a fortnight before July 24th at Bamburgh on the east coast. In that time I saw whole fields taken off; some were ploughed up and resown; these were mostly Swedes; they were all well forward, a great many being closed over the ridge.

"We are fourteen miles from the sea, close to the foot of the Cheviot Hills. There is no doubt the moths have come from the sea, as the Turnips are more affected as you get nearer the coast. Here we have suffered very little damage."

Replies to inquiries in circular (see p. 110), August 11th:—

(1). "I have suffered no loss, as I took means to remove the caterpillar before they had time to do any damage except making holes in the leaves in some parts of the field.

(2). "By keeping the scufflers going with birch branches attached. I sent a letter to the 'Newcastle Daily Journal'* (which I enclose); it

* "*The caterpillar plague.*—Having tried most of the remedies recommended for the destruction of the caterpillar, the most effective I have tried are birch branches tied on the front of the scuffler, and projecting well over on both sides so as to completely cover the drills on each side. By this means each drill is gone over twice, and the insect completely cleaned off the plants and buried up by the scuffler. The caterpillars were first noticed here on Friday, the 24th; they have not yet had

was copied by the local papers, and has been tried by several people all over the county. Where the Turnips were brushed before the caterpillars had time to do much damage, it removed them in large numbers. I tried dusting with quicklime on the under side of the leaf; it did not kill them. Going back next morning I found they had eaten part of the leaf, lime and all, and were still as lively as possible. I also tried paraffin and water, one to fifty, put on by a garden syringe with a very fine rose; the only effect I could see it had was keeping the birds off that part of the field.

(3). "The cold weather and heavy rains we had during the week ending August 1st killed great numbers.

(4). "Part red clay, but mostly whinston gravel. All the land I have Turnips this year (100 acres) has been limed within the last four years at the rate of 7 tons shell lime per acre. All my Turnips are after Oats. The land was all ploughed during autumn and early spring about ten inches deep; it all had two furrows just before sowing. Thirty acres of Swedes had 15 loads farmyard manure, 5 cwt. Thomas's phosphate powder, 2 cwt. kanit, and 1 cwt. nitrate of soda put on the ridges and split in just before sowing; 10 acres had the same quantity of farm manure ploughed in during autumn. Also the same artificial per acre, and the ridges split before the seed was sown. After having the caterpillars brushed off, I top-dressed the whole with ½ cwt. nitrate of soda and 2 cwt. salt per acre. Now it is scarcely possible to tell whether anything has ever been on them, they are looking so well.

(5). "Here we do not clean our land until just before sowing; the weather at the time could not have been better for cleaning land. I never sowed my land in better order. They were all sown by May 26th, which is considered early for this district. There was no particular weed noticeable.

(6). "In examining the fields of Swedes, I found a few caterpillars on some stray plants of Charlock, but nothing like the numbers in proportion there were on the Swede leaves. I have 60 acres of yellows and whites, and the caterpillars have scarcely been noticed on them at all.

(7). "There have been thousands of Starlings, green and golden Plovers, Gulls, Chaff- and Greenfinches, frequenting all my Turnip fields for some weeks, and I have no doubt they have cleared thousands of caterpillars off daily during that time."—W. P.

Mr. Hy. Annett, writing from *The Cottage, Widdrington, Northumberland*, noted.—"As large areas of Turnips are apparently being

time to do the damage caused along the coast, and by keeping the scufflers going I hope to be able to save the greater part of my crop."—Wm. Pringle, Branton, July 29th, 1891.—From 'Newcastle Daily Journal,' July 30th, 1891.

ruined in this immediate district through the attacks of what I presume is a caterpillar, I forward by same post specimens of the 'worm,' and the results of their handiwork." Specimens of Diamond-back Moth caterpillars were sent accompanying.

Marden, Whitley, Northumberland, August 12th. From Mr. Fenwick Wilson.

Replies to inquiries in circular (see p. 110) :—

(1). "30 acres of Turnips and Swedes affected to the average amount of £5 per acre. Most damage is done near to hedges ; for a considerable distance no Turnips whatever are left.

(2). "Only measure taken was heavy dressing with salt sown broadcast, which did not appear to do any good.

(3). "Caterpillars appeared during very dry weather, which was followed by very heavy rains and thunder showers, but they had no effect on caterpillars, which, in fact, did most harm during and immediately after rains.

(4). "A. Moderately strong ; was deeply ploughed in spring, twice cross-ploughed, and well cultivated. B. Manured with town manure on stubble and ploughed in, and heavily manured with fold manure in drills just before sowing seed (no salt used as manure).

(5). "Practically no weeds.

(6). "Affects Charlock about the same as Turnips.

(7). "Starlings and Lapwings have done much good in clearing caterpillars ; Sparrows and Rooks are occupied with early Oats ; no time to spare for caterpillars."—F. W.

Cheviot House, Berwick-upon-Tweed, July 28th. From Mr. F. Norman. After some observations on the great extent of Turnip land in the district, and the wide spread of the caterpillar scourge on the crop, Mr. Norman observed :—"I was examining the Turnips last evening in the fields. A pitiable sight. The leaves of acres upon acres quite bleached and frosted in appearance from the light of the declining sun shining through the epidermis, which the caterpillars considerately leave intact.

"In this district the cocoon-spinning has begun, and is fast proceeding. The terrible idea now forces itself forward,—Will there be another brood of moths, eggs, and caterpillars from these chrysalids *this year* to attack the present plants which survive, and those of a second sowing where that is ventured upon ? "

October 6th. The following remark by Mr. Norman accords with that of other observers who notice the great leaf growth following on the rains.—"I am glad to tell you that the Turnips in this district are very good indeed. The truth was that rain came on in the nick of time, and enabled the tops to more than recover themselves from the state of debility to which they had been reduced by the caterpillar."

October 26th. The following observation also accords with only too many others as to the deficiency of bulbing which often accompanied the splendid leafage.—"Since I wrote to you I have had an opportunity, in going the rounds here, of speaking to some of the farmers of the district about their Turnips. They agree that the Turnips are looking splendidly, but nearly all say that they are behind in bulbing owing to the severe check which they received from the caterpillar."—F. N.

SCOTLAND.

Berwickshire.—*Gunsgreen, Eyemouth, N.B.*, July 21st. From Mr. James Gibson, with specimens accompanying. A large number of specimens of Diamond-back Moth caterpillar were sent, and of these a much larger proportion were still young than was the case with specimens from more southerly localities. The leaves forwarded were about six to eight inches long, and about three-quarters of the leaves might be estimated as destroyed in the case of those least attacked. Some were reduced to little but the veins and ribs, with the remains of just the filmy cuticle of the upper side of the leaf connecting them. —Ed.

Mr. Gibson wrote on July 21st:—"An unusual pest has recently fixed on the Turnip crop in this particular part of eastern Berwickshire. Until ten days ago the Turnips appeared quite healthy, and promised to be an abundant crop. When working through the fields end of last week, I observed a few of the leaves drooping, and on examination found small perforations on the leaves. Minuter examination showed that some small caterpillar, or other animal, or insect had wrought the mischief.

"As the weather was showery, I thought that the plant would overcome the damage; but instead of improving, the plants are disappearing by acres, and what looked a promising crop ten days ago, I fear will now prove a complete failure.

"Not only the damage is not confined to my own farm, but various holdings within an area of three miles appear to be similarly affected."

On the 28th of July, Mr. Gibson wrote:—"All round the coast here the plague of caterpillars is very prevalent; inland it is not so bad."

Replies to inquiries in circular (see p. 110), August 10th:—

(1). "I have about 80 acres under Turnips this season; from this area I do not expect to have more than 30 acres, and this a very poor crop indeed. As far as I observe, the attack has been very severe along the coast here from within three miles of Berwick-on-Tweed, stretching for ten miles, and about one and a half miles inland.

Beyond that distance inland it gradually improves until the crops promise to yield very abundantly.

(2). "My experience was that lime or soot dressing had very little, if any, effect. Nitrate of soda or superphosphate I did not try, as the pest was making such rapid progress; and (as I advised you) I tried sulphur fumigating, as previously explained, which took the caterpillars off the leaves, and thereafter I ploughed them in.*

(3). "I am of opinion that the heavy rains, high wind, and cold weather that we had for two or three days had great effect in checking the ravages; the constant beating of the rain, the tossing by the wind, knocked them off, and the chill appeared to deaden or paralyze them.

(4). "The land round about here is particularly adapted for raising a Turnip crop. It is autumn cultivated, and is ploughed to a depth of not less than nine inches. Part of the land is manured with curtain dung ploughed in, and when the Turnips are sown, artificial manure is used by being sown in the drill. No salt is used in this quarter; the land does not require it, owing to the constant presence of saline particles from close proximity to the sea.

(5). "The weather here last autumn was fairly dry, nothing abnormal, and allowed the ground to be well cleaned. No particular rush of weed was observed.

(6). "Yes, from my own observation; and any of this weed which happens to be among the Turnips is stripped to a skeleton.

(7). "As far as I have seen, Crows and Sparrows were the birds that devoured the caterpillars chiefly. Sea Gulls, although following the plough in thousands, and during the manuring time, did not take to the grub. The Crows had to be 'herded' by boys from the Potatoes, when all at once they were observed to leave the Potatoes for the Turnip fields, and were no doubt helpful in drawing attention to the scourge in the first instance. Although near here I observed the Starlings when they came here in clouds in the early spring, and where they yet remain, I cannot say that I have seen them feeding on the grub in any numbers."

* Mr. Gibson here refers to a plan, arranged by his steward, for fumigating Turnips by means of a sort of sledge about ten feet long, and wide enough to cover two drills of Turnips. At the two ends and in the middle, "under the upper side of the top floor there are three pots in which pure rock sulphur is kept burning. The apparatus is open at both ends, save for curtains of sacking."

This apparatus was drawn by one horse, and the united effects of stupifying the grubs by fumigation, brushing them down by rubbing of the sacking, and finally burying the fallen grubs by a small plough following the fumigator, was found to answer well. I have, however, been afraid to recommend it, as without careful management the apparatus might injure the Turnip, or the sulphur fumes possibly be injurious to the leafage.—Ed.

On October 20th Mr. Gibson noted further:—"My worst anticipations regarding the destruction of my Turnip crop have been realised. In all my experience I never saw such a failure. The fields are more like a wilderness than rich arable land."—J. G.

HADDINGTONSHIRE.—*Queenstonbank, Drem, N.B.*, July 23rd. From Mr. John A. Begbie.—"I send you a box containing some leaves of Swedes and yellow Turnips, in which you will find a caterpillar which appeared on our Turnip crop a few days ago, and which has already done a great deal of harm." (Specimens sent showed that some of the Diamond-back caterpillars were then spinning cocoons for change to the chrysalis state.—ED.) "The whole of this district along the sea-shore, from Dunbar as far as, say, about thirteen miles from Edinburgh, appears to be attacked; but inland I have heard of no damage—indeed, a friend who farms within ten miles of me (but inland) says he has none of it.

"In Fife I hear it is also bad, in some places so much so that they have had to plough up the crop. We thus have it on both sides of the Forth. Whether it is confined to this district or not I do not yet know.

"Early Swedes and yellows in some places have escaped, while later plants are stripped to skeletons; but elsewhere I have seen an early field of yellows quite white, and no doubt they will shortly be eaten bare.

"We have had very high temperature, and a very short rainfall in June, and up to this last week, when heavy rain fell on Tuesday and Wednesday last, and to-day, the caterpillars are, I think, much fewer. I am top-dressing with nitrate, which I hope may rush the crop (90 acres) out of trouble."

Replies to inquiries in circular (see p. 110), August 15th:—

(1). "*Estimate of loss.*—Crops which were far on have suffered very little, while those which were later in the same district, and even in the same field, have been almost, or sometimes totally, destroyed, so that an estimate of loss is, at the present time, impossible. A 43-acre field of Swedes of mine looked miserable about the end of July; but now, having been top-dressed with nitrate, and pushed on by moisture and heat, it is looking, except in a few spots which were badly bitten, a very fine crop. And until the end of the year it will not be seen if the damage done in July has affected the yield. If we have open growing weather in the back end, the chances are that the loss of time and damage may be fully made up.

"17 acres of yellows on my farm have suffered severely, and I have sown 150 lbs. of Rape, and harrowed it in between the drills of the Turnips. The loss of Turnips may be overhead 30 per cent. In some places the whole crop is gone; in other spots it is not touched.

"26 acres yellows, where early sown and got rain, came away wet, and there is practically no damage; where later it is considerable, perhaps 20 per cent.; but taking it overhead on that field the damage may be only 5 per cent., as the larger part of the field is all right. This is an illustration of how difficult it is to form any reliable estimate, or indeed any estimate at all.

"In this field I left about two acres of wet dirty land some way into the field and pushed on with the rest; these two acres were therefore later. On both sides of this strip the crop is splendid, while it was eaten very badly.

(2). "I sowed 1 cwt. per acre of nitrate of soda on 43 acres Swedes and 10 acres yellows, and 2 cwt. soot on one acre Swedes. All have come away well, and done better in resisting, or rather overcoming, the damage, than what was not top-dressed. Grubbing, I think, has helped crops which were far on, by the rough disturbing of the leaves.

(3). "Heavy rain marked the first stoppage of damage, but I think high winds and a lower temperature on the night of the 22nd of July, and during the last four days of that month, were also of great benefit.

(4). "26 acres stiff clay, ploughed in January medium depth. Manure—4 cwt. superphosphate, 37·40 per cent.; 4 cwt. dissolved bones; 2 cwt. nitrate. No salt.

"17 acres light sandy land, ploughed in April. Manure—3 cwt. bone meal; 1¼ cwt. bone flour; 1¼ cwt. cod fish guano; 2½ cwt. superphosphate, 26 per cent.; ½ cwt. nitrate. No salt.

"43 acres stiffish land, ploughed in February. Part dunged, on the stubble of which 10 acres got 4 cwt. slag; 1½ cwt. bone flour; 1 cwt. nitrate; and 13 acres got 2 cwt. super., 37·40 per cent.; 2 cwt. dissolved bones; 1 cwt. nitrate. The other 20 acres with no dung got 3 cwt. super., 37·40 per cent.; 3 cwt. dissolved bones; 1½ cwt. bone flour; 2 cwt. nitrate. No salt.

(5). "The season was dry. Rainfall as follows:—1890: October, 2·61; November, 3·62; December, 1·65. 1891: January, ·85; February, ·15; March, 3·14; April, ·58. Cannot say I noticed anything unusual in the weed line.

(6). "Yes.

(7). "I am told that Crows and Starlings were seen among the caterpillar-eaten Turnips. I must say I saw them there no more than usual; and Sparrows and smaller birds preferred the Barley." * —J. A. B.

* The following "general remarks" of Mr. Begbie's are, I think, of very serviceable interest, relatively, not only to the effect of amount of rainfall on the infestation and on the condition of the attacked crop, but also the effect of the

Fife.—130, *North Street, St. Andrews, N.B.*, July. From Mr. Andrew Balsillie. The first publicly recorded observation of the appearance of the Diamond-back Moth during the past season was, as far as I am aware, that made by Mr. Andrew Balsillie, of St. Andrews, and communicated by him at the time (on July 21st) to the 'Scotsman' newspaper. Afterwards, on request for information, he wrote me that on the very last days of June an extraordinary number of small grey-brown moths were observed all along the eastern seaboard of the county of Fife infesting the Turnip fields. Their appearance was coincident with a period of long-continued drought, and though the plants had brairded, they were making exceedingly little progress. On Monday, July 20th, or as nearly as may be three weeks after the appearance of the moths, both Swede and yellow Turnips presented the appearance as if lime had been sown on them. On looking more particularly, it was found that the plants were infested with small green caterpillars which had eaten the under side of the blade, leaving the thin film on the surface. In this way whole fields were destroyed. In other cases portions of a field seemed to escape with comparatively little damage.

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method of fall, *i. e.*, whether penetrating, or in small quantities rapidly drying up. Mr. Begbie also alludes in the last lines of his remarks to the high minima of temperature at the time of appearance of the pest, which (as he remarks) was very likely to help their development. The minute meteorological details, with which he favoured me, are too long for publication here.—Ed.

"General Remarks.

"After the frost of last season the land was in fine order, and Turnip sowing was commenced about the 1st of May. With a fair amount of rain in that month the early-sown fields got well away, though for a time they were kept back by cold east winds. In June we had only ·28 rain, and though the heavy dew and hoar kept the brairded Turnips growing, the unbrairded seed came away in patches. Up to the 15th July ·65 rain fell, but in such small quantities as to do only the growing Turnips good. On the 17th and 18th July, the caterpillar appeared and simply ate up all the weakly plants which had come away in patches, and did much damage to fields which had stood still in June, not being far enough on in the shaw to catch the dews and hoar.

"Heavy rain on the 21st and 22nd, and a lower temperature, marked a change, and by the end of the month the caterpillars were much fewer in number, and now (15th August) are entirely away. The rain of 21st and 22nd July brairded all seed which was yet to come, and these are all now singled and doing well, though it will take a very open growing back end to make them a crop at all.

"I quite think that if we had had rain in June, the whole crop would have been as much beyond the reach of the caterpillar as the early-sown crops, which got well away in May, proved themselves to be.

"I enclose a note of temperature, &c., in July for three years, and on charting the minimum readings the high temperature from the 13th to 21st July of this year is very apparent. This may have helped the development of the plague which appeared during that time."—John A. Begbie.

Replies to inquiries in circular (see p. 110), August 11th :—

(1). "Evidences of the ravages of the caterpillar may be seen at least six miles inland, and I should estimate that from a third to a half of the crop has been destroyed. Resowing has been attempted in many cases, but it is yet too soon to say what the result may be. On Saturday I observed a second brood of the moth, but in numbers not nearly so numerous as on the first occasion.

(2). "Soot and nitrate of soda have both been freely used (near St. Andrews, Fifeshire) in this district, but I am doubtful if either had much effect upon the caterpillar. The remedy was attempted too late; in fact, just at the time the caterpillar was spinning its cocoon. It was beneficial, however, in a secondary manner, as it would push the plant into more vigorous growth. In other cases scufflers with boughs were sent through the fields.

(3). "We were certainly fortunate at the time the attack was worst in having heavy rains, or otherwise I believe the result would have been even more disastrous.

(4). "In some cases whole fields were destroyed; in other cases portions of a field seemed to escape with comparatively little damage.

"On inquiry into the reason of this, it was at once apparent that it depended to a large extent on the nature and condition of the soil, and the state of plant-growth at which the attack had commenced.

"Early-sown Turnips in good soil, both as regards mechanical and manurial condition, survived the attack and continued to grow, while on hard clay soils, and on back lying soils trending to the north, and where the attack had commenced shortly after or during thinning, the plants were entirely eaten up.

"There is no doubt that the best preventive is to have the land in high-class condition. In a field, for example, which was well done to, a portion which got an extra dressing, from the more vigorous growth of the plant, seemed almost to have escaped.

(5 and 6). "So far as I have observed, there was nothing exceptional in the weather during the autumn to account for the visitation; nor have I heard of any particular weed unusually noticeable. It ought, however, to be noted that the attack has been found to extend to all members of the Cruciferæ (excepting Cress),* including Brussel Sprouts, Cauliflower, Raddish, Wallflower, Charlock, &c., so that there is ample opportunity for the perpetuation of the species during the winter.

(7). "I have no doubt but that the Starling and the Sparrow have

* Cress also is liable to infestation. I had specimens of Cress plants, which had been left for seed, sent to me from near Kelvedon, Essex, with cocoons on them then containing spun-up caterpillars or chrysalids of the Diamond-backs, from which the moths presently developed.

assisted largely in mitigating the evil. Possibly the Rook may have also eaten a number of the caterpillars, but of that I am not certain." —A. B.

On the 28th of Dec., in reply to my inquiry requesting information as to yield of Turnip roots, Mr. Balsillie favoured me with the following observations:—"It is the general experience in this district that where the Turnip crop escaped complete destruction by the Diamond-back Moth, the yield is about 25 per cent. under an average. Some weeks after the ravages of the caterpillar had ceased, the luxuriant leafage gave promise of an excellent crop, and farmers were congratulating themselves, after the gloomy prospects of August, that they would have about an average yield. Had the weather been propitious in the autumn months, their hopes would in all probability have been realised; but the rainfall, both in October and November, was excessive, the soil became water-logged and cold, and bulbing was almost at a standstill. The result was seen when storing came on, in the large proportion of small Turnips. The check which the plants received in July was something like a month taken from their growth, and the later conditions being unfavourable they did not have an opportunity of making up leeway. This was also noticeable in resowings, which never came to anything."—A. B.

Coates, Largo, Fife, July 7th. From Mr. John Lee. At this date Mr. Lee forwarded to me specimens of small moths (of which some samples had been sent me in the previous week) for further investigation, but, having been rubbed in the postal transmission, I had not been able to identify them as Diamond-backs. In this case also I could not name them with certainty; but from the nerving of the wings, where the scales forming the pattern was rubbed off, they appeared to be *Tineas*, and were of the size of the Diamond-backs; therefore, as there was a severe outbreak of caterpillars about three weeks later on the fields where the moths were seen flying about, it scarcely seems open to doubt that these were part of the flock of Diamond-backs which appeared on those parts of the coast. On the 7th of July, Mr. Lee noted that no caterpillars were seen in the Turnips although carefully searched, but the moths were very numerous, especially in those Turnip plants which had not been singled.

Replies to inquiries in circular (see p. 110), August 14th:—

(1). "I should say the damage done will not amount to one-fourth of the whole crop grown.

(2). "Several farmers have put in boughs of trees in the scufflers; but none that I am acquainted with have applied anything but nitrate of soda, not with the idea of it killing the caterpillar, but to force on the growth of the Turnips. So far as brushing them off is concerned, I find they again ascend the Turnips from the ground;

and if buried under three inches of earth at once find their way to the surface.

"I put on my ploughs a good firm bundle of Wheat straw, bent down at the ends, so as to rub the under part of the leaves without damaging them, which the boughs are apt to do.

(3). "I do not think rain has any effect in killing them. A high wind I fancy is more effective. The land on which the Turnips are worst is generally stiff, but not always.

(4). "Those plants on parts of fields which are destroyed are generally those which were not in a thinning state when they were attacked.

"The depth at which the land in Fife is ploughed in stubble is from six to eight inches. The manure used is very generally half-dung and some light manure. No salt.

(6). "The caterpillar seems to eat the Charlock much in the same way as the Turnips, neither more nor less.

(7). "During the time the caterpillars were most plentiful, the Starlings and thousands of smaller birds might be seen feeding on them."—J. L.

Rathillet, Cupar, Fife, July 20th. From Mr. Dav. Carswell, with Diamond-back Moth caterpillars sent accompanying, as specimens of a grub which was eating, to a large extent, a field of yellow Turnips belonging to the sender, and on the following day Mr. Carswell communicated further:—"Since writing you yesterday, I have heard in the market here to-day great complaints of the green larva, specimens of which I sent you yesterday, all over Fife; some fields are almost eaten up.

"When in the field this morning I saw a great many white moths, which, I presume, are the progenitors of the larva. On looking at my two fields of Swedes I find them both affected. It is apparently to be a great scourge in Fife."

On July 23rd Mr. Carswell wrote further:—"Notwithstanding very heavy rains, I find the caterpillars still very numerous on the under side of the Turnips this morning, and a great many moths flying about, so that I am afraid a Strawsonizer and water will have no effect. Some of my neighbours are trying nitrate of soda and superphosphate, and another soot. These may stimulate the crop, but I am afraid will do nothing to destroy the caterpillar, as it seems impossible to get at it, unless, as you propose, by brushing it off. It appears as if whole fields would soon be completely eaten up."

On the 11th of August, Mr. Carswell noted that "the Turnips on this farm have improved very much since the rains and some cold nights. There are now very few caterpillars to be seen; but on one field especially, and that the one that was most affected, the moths are

in thousands. It is a field of yellow Turnips, and was the last field sown."

Replies to inquiries in circular (see p. 110), August 18th :—

"I have been making inquiries into the ravages of the caterpillars of the Diamond-back Moth in this district, and beg to give the following answers to your questions :—

(1). "Estimate of amount of loss about one-fifth.*

(2). "Nitrate of soda, &c., have been very beneficial; do not know of other remedies having been tried in this district.

(3). "Heavy rains and cold nights did immense benefit.

(4). "Land generally black loam on whinstone; some fields on sand, late sown, were worst. No difference observable to any extent in time or manner of ploughing. Manures—Nitrate of soda, guano, Liebig's meat meal, superphosphate, bone meal and flour; some cases kanit. No salt.

(5). "No.

(6). "No.

(7). "Yellowhammer, Wagtail, and Linnets."—D. C.

On the 7th October, Mr. Carswell favoured me with the following note as to state of Turnips up to date :—"The Turnips here improved very much after the rains, but they are not in many instances bulbing well, and will be a small crop, unless we have an open winter; and this I attribute very much to the severe check they got from the caterpillars, although latterly we have had too much rain and too little sunshine."

Seed and Nursery Establishment, Stirling, N.B., July 23rd. From Messrs. W. Drummond and Sons, regarding attack of caterpillars of Diamond-back Moth.—"We have complaints of it from the east and north of Fife, from Kinross, and from Forfarshire; in nearly all cases from the districts near the Firths of Forth and Tay, where the rainfall during the early part of summer has been less than in most parts of Scotland. Over a considerable part of the area heavy rain has fallen since the beginning of the week, and we hope to hear that it has interfered with the ravages of the caterpillar."

June 24th. "Additional specimens have reached us this morning, and we hear that there are slight attacks in our own neighbourhood."

* "My report applies to the north of Fife. Turnips have improved very much of late, and it is difficult to estimate the loss, as so much depends on the future, and whether or not we have early frosts. Land in the highest condition and properly cultivated has suffered least.

"In my own case, having given the Turnips a large quantity of manure when sown, I did not give anything afterwards, and the loss will not be one-tenth; others one-third. The late-sown Turnips as a rule have suffered most. The east coast of Fife seems to have suffered more than inland."

Replies to inquiries in circular (see p. 110), August :—

(2). "Light ploughs and other implements, with brushes attached, were generally thought to be very serviceable ; and it was remarked that the mere action of the horses' feet brushed off many of the caterpillars where the leaves were large.

(3). "Heavy rain *not* thought to reduce caterpillar, and to be beneficial only in promoting vegetation.

(6). "Very destructive to Charlock."—W. D. and Sons.

Letham, Leven, Fife, N.B., July 24th. From Mr. David Crole, jun. Specimens of caterpillars of Diamond-back Moth sent accompanying, some full size.—"I lease an arable farm in this district (east of the county of Fife), and the Turnip crop is one of the most important. Within the last few days the Turnip crop on this farm has been attacked by what I have been told is the larva of the Diamond-back Moth. The leaves have been stripped, and also holed (perhaps the latter, the first operation in the depredations). We have not had such an experience before in Turnip cultivation in this county, nor I believe in Scotland."—D. C.

Kenneston, Leslie, Fife, N.B., July 25th. From Mr. J. Beveridge, with specimens of Diamond-back Moth caterpillars accompanying, some spinning up.—"I am sending you some specimens of caterpillars that have attacked the Turnips in this neighbourhood. . . . . I have 20 acres that seemed all right a week ago; now it is riddled, and seems in a fair way to be entirely destroyed. I am dressing it with nitrate."

Replies to inquiries in circular (see p. 110), August 13th :—

(1). "I can form no estimate yet as to the loss, as the Turnips are growing so fast now that they may be a fair crop yet, except about one acre out of twenty, which is totally eaten up.

(2). "I put on about 1 cwt. of nitrate and 1 cwt. of salt per acre. I do not think this had any direct effect on the caterpillar, but has helped the Turnips very much. We have also been hand- and horse-hoeing as close to the Turnips as possible.

(3). "The heavy rains we have had have done more good than anything else; even the first shower after the attack began had a wonderful effect. My neighbours all concur in this opinion.

(4). "The land is alluvial deposit and sand, and formed part of the old bed of Loch Leven. It was five years in grass, Oats last year, and was ploughed in December rather wet, and not touched again till June 1st. The Turnips were made with farmyard manure and about 5 cwt. of nitrate of soda and super. ; no salt.

(5). "The weather after November last was very wet ; but noticed no particular weed.

(6). "No Charlock.

(7). "I have seen no birds near the field except Larks."—J. B.

Easter Kincaple, St. Andrews, Co. Fife, N.B., August 8th. From Mr. George Dun, with specimens of the upper part of Charlock ("Skellock") stems sent accompanying, with the leaves showing characteristic workings of Diamond-back Moth caterpillar. (Turnip leaves very much injured also forwarded, and some specimens of the caterpillars, Ed.) Mr. Dun had previously reported, on the 3rd of August, that he had fifty acres of Turnips badly eaten by caterpillars. On the 8th Mr. Dun wrote further :—

"I send you a few of the leaves that have been attacked. I noticed my Turnips attacked three weeks past yesterday, and the moths in droves. On Wednesday last I saw again a large number of moths, but not so numerous. I am afraid they are to master ten acres of Swedes, although in the beginning of this week I had hoped they were to turn out a fair crop; they started with me when dunged in the drill, the Turnip plant, after being thinned, sitting dry on the top of the drill. I send you the only Skellock I can get in the field, but they were quite as badly infested as the Turnips (the field is clear of weeds)."

Replies to inquiries in circular (see p. 110), August 10th :—

(3). "The growth started after a very heavy thunder-shower on the afternoon of the 22nd July; on the 27th they showed decided improvement. Yesterday we had a fine heavy rain, and to-day the crop is looking better.

(4). "My Turnip break was all ploughed again in spring, and reduced to a fine mould, and brairded with the aid of showers the last week of May. I noticed my Turnips not thriving, and all holed on 17th July in field of Swedes, 25 acres in extent, drilled east and west. This field lies 20 ft. above sea-level; sandy subsoil, heavy loam in high condition, within 500 yards of the River Eden, where the tide rises to daily. Fourteen acres of this field were dunged during winter with 10 loads of dung; the end rigs also. The remainder of the field was dunged in the drill with 10 loads well-rotted farmyard dung, both plots getting 3 cwt. best herring guano, 3 cwt. superphosphate, and ½ cwt. nitrate per acre, sown when the land was drilled, and sown with Turnip. On 20th July I dosed the whole Turnip crop on my farm with ½ cwt. superphosphate and ½ cwt. nitre, sown with two hands, taking two drills at a time, so as to reach and protect the heart of the Turnip from the caterpillar.*

* I have omitted to mention that my Turnips, where dunged in the drill, have been by far the worst. My yellow Turnips are making a better recovery than the Swedes, but are nearly all double shawed.

(5). "The weather has been exceedingly dry here for two years, except on two occasions; no water has run off the surface.

(7). "I consider the Starling the most useful bird we have in clearing the caterpillar; they have been very active of late, and very numerous. Sparrows are too numerous, and are against the Swallows."

Kirkmay, Crail, Fife, N.B., August 19th. From Mr. John Duncan. —"In this district (East Neuk of Fife) the weather has been very dry, there only being 6¼ in. of rain for the first six months of the year. In July, when the moth and caterpillar appeared, the Turnips were at a standstill for want of moisture, and I am of opinion that to that cause alone can be attributed the attack, as vermin of some sort is sure to attack a plant if it is unhealthy or not growing. As an example, I have a field of Swedes, on cold-bottomed land, which had never stopped growing, and have therefore scarcely been touched, except on the two end-ridges, where the crop was not so vigorous; whereas another field, on very dry light land, has been considerably damaged. Again, six miles to the westward, where there has been more rain all the season, the damage is not so great as in this corner. The moth is still very plentiful, but as we have now had rain, I do not fear a second attack. I have often observed the same moth in previous years in walking through old pastures, and at sides of roads, hedges, &c."

Replies to inquiries in circular (see p. 110), August 19th:—

(1). "I cannot give an estimate of my loss further than to say that it has made my crop, *where affected*, four weeks later; but on a farm in this neighbourhood one-third of the crop is almost destroyed and part ploughed up, and the other two-thirds were much affected.

(2). "I have tried no fertilizers, but have no doubt but that nitrate of soda would help to push on the crop, and thereby lessen the amount of damage. On a light land farm of mine in the next parish my grieve tied boughs to the *front* of a horse-hoe, and brushed off numbers of the caterpillar; the tines coming after buried them in the earth. The fields so done have not suffered much.

(3). "Heavy showers, with an extremely low temperature on 28th July, destroyed great numbers.

(4). "As said before, crops on dry light land suffered most; the land was ploughed in autumn and early winter, and worked and cleaned before seed-time. The same manure was used for all Turnip crops, *viz.*, farmyard manure, Ichaboe guano, and superphosphate of lime.

(5). "Previous autumn wet, but did not interfere with cleaning of Turnip break. No particular weed noticeable.

(6). "Having no Charlock, I cannot say.

(7). "The *Starling* is *by far* the most useful, and the Rook to a certain extent."

On the 12th of October Mr. Duncan further added :—"The earlier-sown Turnips, which were better able to bear the attack, are now a fair crop; later-sown ones have now a lot of leaves, but the bulbs are small."

Forfar.—*Inverpeffer, Carnouslie, N.B.*, August 11th. From Mr. J. Swan.—"If not the first victim, I was the first in this county to note the sudden attack, and sent off specimens of plants to Messrs. Drummond. We left off working (*i. e.*, hoeing) yellow Turnips on Tuesday, 14th July, in a field, fearing nothing, except that we were parched with drought, and was absent for two days till Friday, July 17th; and on Tuesday evening neither I nor any of my workers saw any sign of danger or damage. On Friday morning not a single plant in ten acres was safe; all the leaves like lace. The next field, over the wire-fence, was Swedes—begun to meet in drills—and the large, broad, luxuriant leaves were a pitiful sight; and in both fields the caterpillars were in millions. There were evidently two broods at work, one $\frac{4}{8}$ in. to $\frac{5}{8}$ in. long, the thickness of a knitting-needle; the other $\frac{2}{8}$ in. to $\frac{3}{8}$ in. long, and small in proportion. In this field of Swedes—20 acres—two acres had been sown a second time with yellow seed, and they grew so rapidly as to be thinned on the seventeenth day after seeding, the quickest, in my experience, in 50 years. In 48 hours not one plant left alive. Westward ho! was the word, and, passing two fields of Wheat, entered a second field of 20 acres saved, and these were so extra luxuriant that the moth failed to do so much damage; but 6 acres yellows in west of same field were all but killed; they are only now recovering. This evening I find a late division of $9\frac{1}{2}$ acres yellows, all thinned a fortnight ago, not 100 plants left; resown a week ago with Rape-seed between the rows of Turnip, so that, should the Turnip perish, the Rape would be well started; and I have to report a fine braird of Rape everywhere, whether sown over and among moth-eaten yellows or where the yellows are clean away."

Replies to inquiries in circular (see p. 110), August 11th :—

(1). "Over an area of 30 acres Swedes, 25 to 30 per cent. of deficit must be recorded, and over 30 acres yellows 15 are a total loss, and only Rape instead; the other 15 may make 50 per cent. of average. The money loss cannot at this early date be accurately recorded.

(2). "Nitrate and super. the best stimulants, and unfailing in good results; no dry or dust applications, nor any chance of Straw-sonizer or sprayer; but practically, over 60 acres, no time, or water, or machines to overtake the work.

(3). "Heavy rain did much good falling on dry parched surface,

dashed the sand and mud on to under side of leaves, and made the life of the caterpillar no sinecure.

(4). "My land all natural Turnip land; loam with sand, or sandy loams and clay loams. First field attacked was twice scarified in the fall of 1890, and all stubbles and weeds raked off; deeply ploughed (8 in.) in February, and again in May, and dunged in drills. Where rotted dung was applied, the plants have outlived the attack; where courtyard dung (fresh), the plants all perished.

(5). "Fine autumn till 20th October; after that, till 1st December, very wet. No particular weeds.

(6). "Scarcely any Charlock on farm; Couch the chief weed. Will send specimens of two weeds which prevail.

(7). "Starlings, Sparrows, Chaffinches, and Linnets very plentiful, and all been most industrious."

Oct. 6th. Estimate of damage resulting from attack:—"The first field of Swedes is so extravagantly luxuriant in shaws (*Anglice*, Tops) as to lead the casual observer to conclude, 'No harm done; splendid crop.' But examine the shaws or top leaves, and you find a double number; the outer rows are the original perforated leaves, in the centre of which have grown up a later or new set of stems and leaves; but examine the bulb, and you find it half the size. The same applies to the yellow varieties that are left. One-third of an average crop, in weight of bulbs, is rather under than over the deficit."

On Dec. 23rd, Mr. Swan, in reply to my inquiries as to what the amount of loss might have proved to be when time of storage or use of roots arrived, favoured me with the following details, which I give *in extenso*, as they meet several considerations of useful interest. The amount of loss; the enormous growth of leafage, so misleading to those unacquainted with the bearings of this shaw for service; the very peculiar method of start of the second growth of leafage; and the serviceableness of sowing Rape-seed to fill in amongst the damaged Turnips. Mr. Swan wrote:—

"First, as to Swedes; I had a firm conviction all through September, October, and November that we were to have a great deficiency in bulbs. The leaves, perforated in July, partly fell off, but a large portion remained, and out of the centre of the first shaw a second growth of leaves sprang up, and where the land was in good condition, whether clay, clay-loam or black land, or sandy loam, all through October not a drill could be distinguished, so rich, rank, and luxuriant was the foliage.

"I was set down as a 'growler' by a party of friends when they looked over a field of 25 acres, and before they walked into it; that field is now, at date, two-thirds cleared, and the produce is 14 loads—perhaps, I may say, tons—as against 28 to 30 seven years ago, being

worked in seven years' rotation; and in 1877—a miserably wet season —24 tons. Only a section of three or four acres in that field had Rape-seed broadcasted in the third week of August, where the plants were too open.

"In the other field, close by the sea-shore, all Swedes, two acres were drifted out and resown, and, you will recollect, sown with yellows, and were thinned just three days previous to the first attack, and completely perished; those two acres, and perhaps over five or six additional, Rape-seed was sown to cover the ground, and give feeding for the sheep; and all over that field the result of storing 1st of this month just gave the same result as to tonnage as No. 1. The foliage in this field was immense, but the roots are not half the usual size.

"The next field should have been all Potatoes, but only half of it was planted, 10 acres; the other half was made yellow Turnips for sheep-folding, and it was in that 10-acre lot I first discovered the enemy. We left this field on the Tuesday evening, and were two days absent in stackyard; I went back to it on the Friday morning, and found it a wreck. Shortly, there, after it was mostly harrowed level and resown, as a test, perhaps three acres were left where the best plants were; but the result was that Rape-seed was broadcasted over the whole 10 acres, and the sheep have just left the field after a safe and satisfactory sojourn of four weeks of 330 hoggets. We carted off perhaps 40 single horse-loads of roots where we thought there was too much feed; that field is fine, natural, friable loam, and used to grow very heavy roots.

"Still a fourth case, where 10 acres of Oats perished by the long drought, and the cattle and sheep were folded over it; these ploughed and made fine, and dressed with 5 cwt. per acre of super., bone-meal, and nitre. These were thinned, but never got farther; drought and moth cleared the lot, all except two acres. We then sowed Rape-seed, but it was late, the land a yellow clay-loam, the autumn cold, and wet; it did not get up so rich feeding as the other fields. None of them were extra dressed; they were all dunged heavily, 20 to 30 tons muck per acre, and from 4 to 6 cwt. of my compound sown with the seed."

Summary of the above by Mr. Swan.—"You will note I have no light to throw on extra dressing after the moth had been, or whilst still in force, in the field; and, so far as my observation goes, nowhere has much or any return been obtained from it, if the land was dunged and dressed at seeding. I think my reseeding and Rape-seeding has done better for both the condition of the land and the feeding of the sheep. I can only say that in 50 years' actual practice the Diamond-back has hit the heaviest blow I have experienced."—J. S.

Estate Office, Haddo House, Aberdeen, N.B. From Mr. George Muirhead, Agent for the Earl of Aberdeen, with specimens accom-

panying of caterpillars of Diamond-back Moth, some spun up. Mr. Muirhead wrote that he was sending a young Turnip with specimens of caterpillars found on its leaves, and on those of adjoining Turnip plants, and desired to know whether the insects were of the same species which were destroying the crops in various parts of the country:—

"The Turnips were first showed to be affected by the insects about two days ago; and five or six acres of the field in which they first appeared have been completely eaten up, so far as the leaves are concerned."

Replies to inquiries in circular (see p. 110), August 24th:—

(1). "No reliable estimate can be given. The damage done by the caterpillar is much greater in some localities than in others. Much loss has been suffered in the vicinity of Udny Village.

(2). "No measures were adopted. One proprietor purchased a Strawsonizer with the view of applying superphosphate, but before he got it used the heavy rains cleared off the caterpillars.

(3). "The benefit of heavy rains was so great that no further measures were needed to get rid of the caterpillars.

(4). "Light brown sandy loam. Autumn cultivated; ploughed about seven or eight inches deep. Manures—bone meal, superphospate and slag; no salt.

(5). "Weather and weeds as usual. Weather was dry at seed-time of Turnips.

(6). "The caterpillars were observed to frequent Charlock.

(7). "No birds were observed to be eating the caterpillars."—G. M.

On the 7th of January, in the present year, 1892, Mr. Geo. Muirhead, writing from the Estate Office, Haddo House, Aberdeen, kindly favoured me with the following information in reply to my inquiries as to ultimate extent of injury from caterpillar attack:—

"So far as my own observation has gone, it has appeared to me that where the moth caterpillars had done much damage to the leaves of the young Turnips they never recovered from its effects; and where the foliage was only partially destroyed the diminished crop showed that the constitution of the plants had been injured. On many farms in this district, if not on all, the Turnip crop this season is considerably below the average, the result it is thought of unfavourable weather generally, combined in certain localities with the attack of the caterpillars of the Diamond-back Moth."—G. M.

To the above Mr. Muirhead added the following communication written on Dec. 29th (1891) by Mr. David Walker, of Coullie, Udny, Aberdeenshire, with the remark:—"I have now the pleasure of enclosing a letter which I have received from one of the principal

tenant farmers on the Earl of Aberdeen's estates, on the subject of your inquiry." It will be noticed that Mr. Walker especially draws attention to the large amount of "double-tops" or shaws, which is a point incidentally mentioned by various other correspondents as one of the objectionable consequences of attack.

Mr. Walker communicated as follows :—"On account of the very dry weather experienced after sowing, the *late* Turnips on this farm are not a full crop. At the same time, I have never had a crop that made more progress at the end of the year. The cause of this is, no doubt, the exceptionally favourable weather that obtained from harvest to the 22nd of Dec., when the ploughs were locked out by frost. Examining the Turnips to-day, I find they have stood the week's frost admirably, and seem, in every way, not a whit the worse for the moth's unwelcome attentions.

"As far as I have seen, the field in this neighbourhood that suffered most from the ravages of the Diamond-back Moth, is one on the farm of Denend, which lies alongside one of mine. At the side of the field earliest sown, and most damaged by the caterpillar, the bulbs are large, and the leafage fairly luxuriant. The Turnips comprised two varieties, purple and green-topped yellows, and I noticed that while only a normal amount of the former were 'double-shawed,' an abnormally large number of the latter displayed this objectionable profusion of leafage. I may mention here that Mr. T. H. Gibson, Culterculleu, had a field rather severely eaten, and he complains of double-tops, but says that otherwise the crop is a good one.

"The other side of the field at Denend may present a point of interest on account of its having been sown about the same time as my field beside it, and having received treatment by top-dressing, * while mine got no manure except what was put in when the crop was sown. The plants in my field are thicker on the ground and of more equal size, and were so from the first.

"Keeping this in view, the chief difference between the two fields is that in the one which got the dressing, the *crown* of the leafage is large and vigorous, but the bulbs lack size and that roundness of form which indicates maturity ; while in the other field the foliage is less vigorous, and the bulbs somewhat larger and much plumper in shape. In my opinion, the top-dressing, while a decided advantage to the early-sown Turnips, has proved of little use to the late."—D. W.

Auchnabo, Slains, Ellon, Aberdeen, August 3rd. From Mr. James Harper, with specimens of Diamond-back attack sent a few days

* P.S.—The top-dressing referred to above consisted of 1 cwt. nitrate of soda applied when the moth had done its worst. The varieties of Turnips mentioned were grown from bought seed and mixed before sowing.—D. W.

later. Mr. Harper, after noting his success this year in lessening amount of Eel-worm attack in his Oat crop, continued :—" I have apparently got out of one pest, but am into another, namely, the Turnip caterpillar ; it has done me extraordinary harm. I have been trying all likely things to get the pest checked, but nothing has done so much good as the weather ; we have had a severe storm of wind and rain from the north, and the pest has almost disappeared. The insects are so secure below the Turnip blades, that nothing I have tried can get at them ; if it had not been for the weather my crop would have been all useless and destroyed."

Replies to inquiries in circular (see p. 110), August 11th :—

(1). " 24 acres more or less destroyed ; about 10 acres totally destroyed, to the value of £100 ; the other 14 acres would be destroyed to about £3 to £5 per acre.

(2). " Tried hot lime, also paraffin, soot, &c. None of them appear to do good, as the caterpillars are fairly secured below the leaves. Scuffling destroys them very much.

(3). " I have no doubt the weather does more to check the attack than anything you can do. We had a week of very stormy weather, and it almost cleared the plants (as you will see by the enclosed).

(4). " Good black land, and in good heart, is free from attack. Heavy clay land is destroyed a good bit, especially where it is of any wet nature. Light mossy land, with a little gravel through it, is entirely destroyed ; nothing left but a few stumps. Manure used—about 20 square yards of good farmyard dung, with about 10 cwt. manure composed of three parts of dissolved bones ; three superphosphate ; three sulphate of potash, and one of nitrate of soda. The land was heavily ploughed.

(5). " The weather was observably wet in previous autumn, but had no weeds to clean, so the weeds could have nothing to do with the attack.

(6). " This is undoubtedly the same caterpillar that frequents Charlock. I have carefully examined it, both with the naked eye and also with a magnifying glass.

(7). " I have noticed the Crow paying particular attention to the worst parts of the fields, so I shot one of them to see what it had in its crop, and found it nearly full of the caterpillars, *hundreds* of them."

Lanarkshire.—*Newton Farm, Newton, Glasgow, N.B.*, August 11th. From Mr. John Speir.

Replies to inquiries in circular (see p. 110) :—

(1). " Loss in my locality is comparatively trifling ; practically speaking *nil*. Most crops of Swedes contain a few caterpillars, but

damage has been confined to very small patches or holes in the leaves; entire stripping of the leaves being very exceptional.

(2). "I am inclined to recommend Paris-green applied by the knapsack.*

(5). "Previous autumn was very wet. The land was cleaned in spring without any difficulty; and no particular weed was noticeable.

(6). "I cannot say that the caterpillar is specially found to frequent Charlock, as I have little of it.

(7). "I cannot speak of any birds being useful, as the caterpillars are too few for the birds to be making a special raid on them."

Argyllshire.—*Inner Hebrides, Foreland House, Island of Islay, N.B.*, August 11th. From Mr. R. Scot Skirving.—"I have to-day seen a local farmer, and he says it has rapidly spread over the whole Island of Islay, its ravages being very severe in some places, and very slight in others. All I have personally seen are near the sea-board of the Atlantic, and it is certainly *worst* there.

"There *is* Charlock (yellow weed, wild Mustard) in Islay, but you may drive a summer's day and not see a specimen, so *that* plant, I may say, has nothing to do with appearance of the grub.

"However, I am informed that recent heavy rains have done much good, and *as a whole* the promise of the Turnip crop in the island is a very good one.

"Though in pretty near neighbourhood to an infested district, no trace of the grub has been seen about this house, either in a patch of Swedes or in the garden."

Two days later (that is, on the 13th of August), Mr. Scot Skirving forwarded me specimens of Turnip leaves, together with cocoons and

* The application of Paris-green and flour (one part of the former to fifty of the latter) dusted on the Cabbages when the caterpillars appear early in the season *before the Cabbage head begins to form*, has been suggested in Canada. And the application is also suggested (with directions) for Turnip leafage. But whatever benefit might result where such applications, whether in the form of spray or dry powder, were carried on under careful superintendence, the risk (at least until the use of Paris-green, *i. e.*, arsenite of copper, is better established and understood in this country) appears to me to be so very great in the case of leafage to be used as food, that I fairly *dare not advise* it.

In orchard use, where the poison is given in excessively weak form, and as spray long before the fruit is in more than embryo state, there is no risk at all of poisoning the eaters. But where the poison is to be applied to leafage of food plants, and it is wholly at the discretion of the owner whether it is given at a date ensuring safety to human Cabbage eaters, or with regard to stock the frequent chance of an open gate, or a gap in a hedge, might by possibility cause loss or injury to valuable sheep, I cannot take on myself to *advise* the application.

If, however, any agriculturist wishes for information on the subject, and will write to me thereon, I will furnish him with details.—Ed.

caterpillars of the Diamond-back Moth, with the observations:—"They are taken from a field near here on my own shooting, but this property has not been much affected, and as rain has at last come (after months of drought) I don't think the crops will suffer. There is a farm some ten miles from here where, I understand, very great damage has been done, acres of Turnips being totally cleared off."

On the 25th of August, Mr. Scot Skirving kindly forwarded to me two letters written to Mr. J. S. Ballingal, of Eallabus, Islay, in reply to his inquiries regarding appearance of the pest, which two communications I append below.

Mr. Thos. Fraser, writing from Ardfin, Island of Jura, by Greenock, N.B., communicated as follows regarding Diamond-back Moth or caterpillar:—"It came on our Turnips (at least we observed it) the last days of July. For the first few days we were a little anxious. The crop was well forward, and as soon as the rain and cool weather came the pest grew weaker, so much so that we do not apprehend any serious damage from it for this season. I observe that the moth is decaying or dying in the first stage now. No doubt the result of the heavy rain we had recently."

Islay and Jura are islands of the Inner Hebrides, Co. Arygle; Jura, which is considerably the smaller of the two, lying north-east of Islay, and separated from it by a channel (approximately) somewhere about a couple of miles wide. It is mentioned in Keith Johnston's 'Gazetteer' that the estimated area of this island is about 84 square miles, or 58,400 Scotch acres, only five hundred of which are arable."

The other communication was from Mr. William Rounsfell, written on August 19th from Persabus, Island of Islay, the locality being one mile from Port Askaig which is on the eastern shore of Islay. In this case it will be observed that the caterpillars had passed away, but the description of the white appearance of the injured leafage coincides with that of the muslined or laceworked appearance given elsewhere:—

"I have not seen the caterpillar on the Turnips yet. My own Turnips looked so fresh that I never thought of examining them till I noticed R. McGeachy's, and especially those on the next farm near the Eoralus March dike, which are the worst I have seen, the leaves being white in some parts of the field. I then looked over my own, and saw the leaves holed also to some extent, but there was no caterpillar to be seen.

"I have seen a yard or two near the head-rigs covered with them occasionally in former seasons, but never over a whole field. They were delicately light green caterpillars, which a little rain would wash off."

IRELAND.

The first information I received of presence of the Diamond-back attack in Ireland was conveyed to me on August 14th by Mr. John H. Franks, Secretary of the Irish Land Commission, Dublin, who observed incidentally in a letter on some other business,—"You may be interested to know that the Diamond-back Moth has appeared in many places in Ireland, especially along the eastern coast."

A few days after, on August 17th, specimens of Swede leaves from Dunany, Dunleer, Co. Louth, were sent me by the Editor of the 'Farmer's Gazette,' Dublin, for examination. These showed unmistakable signs of Diamond-back caterpillar ravage; and characteristic cocoons were also sent, but the caterpillars were too much injured to be quite surely recognisable. I therefore requested further supply of specimens, and on August 22nd was favoured by Mr. W. J. Bloomer, Land Steward, Dunany, Dunleer, Co. Louth, with excellent specimens, both in caterpillar and chrysalis state, of the Diamond-back attack, with the following note:—

"I am requested by the Editor of the 'Farmer's Gazette' to send you box with a small quantity of the moths, supposed to be the Diamond-back Moth, which have done so much damage to my Turnip crop this season, but am happy to say the worst is over, as the heavy rain of the past ten days (which was the heaviest rain I have experienced for a great number of years) did a good deal to stamp out the pest; for had the weather continued dry up to now, I wouldn't have had a Turnip left in the field; and especially the younger ones, a great number of which were completely devoured, where the stronger ones only suffered from small holes through the leaves.

"I am happy to say that, after the heavy rain yesterday, it took some time this morning to collect the small quantity sent you. My Turnip field is only a short distance from the sea, where it seems we have suffered most, as I was speaking to some farmers from the midland counties of the north, but they don't seem to know anything about the little moth they have heard so much talk about.

"I tried the experiment of the small knapsack spraying machine; paraffin oil and soft-soap, under the direction of Commissioner Wrench, Irish Land Commission Department, which, I believe, had a good effect, but with the heavy rain at the same time, I hardly know which to give the most credit to. I am thinking if another season brings down the army of little diamond vipers upon us, I will try to fight them in this way:—I will get a hose attached to my water-cart, and continue to dash the water over the Turnips in the form of a heavy shower; this I will continue until all the moths are washed off, same as I see the heavy rain has done in the present case."

The above notes, it will be seen, coincide with the main points of the English and Scotch observations. The attack appeared near the sea-coast, was most injurious to the weakest plants, and its effects were best checked by heavy rains. Probably Mr. Bloomer's simple plan of dashing water at the plants by means of a hose would be thoroughly serviceable.

I had also a communication sent me by Mr. Champion Russell (of Stubbers, Romford, Essex) whilst at Brockley Park, Stradbally, Queen's Co., Ireland, in which he mentioned that there had been some Turnip caterpillar attack, probably Diamond-back; but that the Swedes in which they were appeared to have out-grown the attack. At the date of observation (August 30th), Mr. Champion Russell mentioned that most of the moths had developed and taken wing, and there were many empty cases. A few cocoons were sent to me, which enabled me to identify the attack with certainty from the moth, as being that of Diamond-back. The above note records the most westerly locality of observation of which report was sent me.

Appearance of moths in great numbers at various localities on the eastern coast about the end of June, and considerations pointing to the probability of the infestations having been blown across the ocean from the Continent.

On August 4th Mr. John E. Robson, of Hartlepool, Fellow of the Entomological Society, and Editor of the 'British Naturalist,' described, in a letter sent by him to the 'Newcastle Daily Journal' (published on August 6th), the enormous quantity of the *Plutella cruciferarum*, or Diamond-back Moth, which had suddenly appeared at Hartlepool on June 24th, together with some other points which, coming from a skilled entomologist, used to identify species and observe habits, were very valuable, as they proved almost beyond possibility of doubt that these vast numbers of moths were not developed on land, but had been wind-borne from the continent of Europe.

On application to Mr. John Robson he was good enough to write me more in detail as follows: "As stated in the letter, I was collecting at a little distance from the coast on the evening of June 24th. On my return home my son gave me a specimen which he had caught in the tennis court, and he described the numbers there as being beyond all he had seen before. They were everywhere and in large numbers. At night I crossed the 'coal staiths' for a short cut, to where I wanted to collect; they were there in thousands,—sitting on every coal waggon, on every bit of iron railway plate, on the wooden palings, and rising like a cloud at every step."

Here Mr. Robson gave me long details as to what kinds of plants grew in the neighbourhood (where there were any at all), and of amount of town land, showing that it was absolutely impossible that the moths should have been bred where they appeared.

The moths, Mr. Robson observed, appeared on June 24th, and did not increase in numbers, but in unsuitable places, such as Hartlepool, they disappeared in two or three days, whilst further away a very small number remained on the coast-edge, but they gradually spread inland.

In his published letter Mr. Robson shows something of rate of progress by mentioning that on the day of appearance at Hartlepool he found none at Hezleden Dene, about one and a half miles from the coast, and on June 26th they were swarming at this locality, having penetrated thus far in two days.

Mr. Robson also brought forward the further considerations: "(1) For a long time previous to June 24th easterly winds prevailed, which would greatly assist the moths in crossing the sea. (2) The impossibility of so large a number of the insects passing through the larval stage without being observed by either farmers, gardeners, or entomologists. (3) Their appearance in such abundance in places like Hartlepool, where there is no food at all for the larvæ. (4) The fact that their ravages were confined to the sea-coast or to a restricted distance therefrom. (5) The fact that on June 24th the species appeared simultaneously in many places."

Mr. J. Burdon Sanderson, of Waren, Belford, about two miles from the coast of Northumberland, wrote me as follows: "My own opinion is that the moth came from abroad somehow or other, as the easterly winds were blowing steadily for some weeks, and the attack seemed to be along the coast and up the Tweed. Whether this is possible or not, I do not know. My brother-in-law at Chatton, seven miles inland from Waren, saw an immense quantity of dead moths along the road extending for some half-mile, evidently killed by a heavy shower which had just fallen. This happened just before the attack was noticed, and nothing was thought of what was to follow. Since writing the above, I have just heard that on the night of July 9th an immense cloud of Diamond-back Moths alighted on the Longstone, the farthest of the Farnes, some five miles out to sea; this is on perfectly reliable authority, and seems to favour the theory that they come from abroad."

This appearance of Diamond-back is confirmed by published information from Mr. H. A. Paynter, Solicitor, Alnwick, who mentioned that, being requested by Lord Walsingham to try to get him some moths, he, Mr. Paynter, proceeded on July 10th to the Longstone Lighthouse on the Farne Islands, where he found the rocks close to

the lighthouse covered with them. The lighthouse keepers informed him that on the previous night such a great cloud of moths was driven over by the north-east wind that they were obliged to keep sweeping them off the lantern throughout the night in order to allow the light to be seen at sea. Mr. Paynter sent some of these moths to Lord Walsingham (who, it may be remarked in passing, is a highly skilled entomologist), who identified them as Diamond-backs.

The chief points of the above appeared in various papers. I quote from the 'Agricultural Gazette' for August 24th, 1891.

Mr. Fenwick Wilson, of Marden, Whitley, also not far from the Northumbrian coast, mentioned: "A common opinion exists in this neighbourhood that the moth crossed over from the Continent. Some fishermen I have spoken to say that about the end of June moths were about the shores in enormous quantities, and were spoken of by them at that time. If it is possible for them to come from abroad that very much supports the theory."

Further north still the observation of a vast appearance of moths on the seacoast was thus reported by Mr. Balsillie, of St. Andrews, Fife: "On the last days of June an extraordinary number of small greyish-brown moths were observed all along the eastern seaboard of the county of Fife infesting the Turnip-fields. Their appearance was coincident with a long-continued drought, and though the plants had brairded, they were making exceedingly little progress. On Monday, July 20th, or as nearly as may be three weeks after the appearance of the moths, both Swede and yellow Turnips presented the appearance as if lime had been sown on them. On looking more particularly, it was found that the plants were infested with small green caterpillars, which had eaten the underside of the blade, leaving the thin film on the upper surface. In this way whole fields were destroyed. In other cases portions of a field seemed to escape with little damage."

Some reference to first observations of appearance of moths preceding outbreak of attack will also be found amongst the observations of contributors, and some further notes on the subject in the following summary.

General Summary.

In the foregoing records of observations, it will be seen that I have given scarcely any which were not accompanied by specimens, so as to enable me to identify the attack.

With many kinds of crop attacks there is no difficulty in any observer, who has once been shown the characteristics, knowing perfectly what is going on; but, as there are several kinds of green caterpillars that feed on Turnip leafage, and, in this instance, the

leaves attacked by no means, in all cases, showed only the "laced work" or "muslined" appearance, which is characteristic of Diamond-back infestation, where the upper cuticle of the leaf still remains but partially injured, it is necessary in working it out to any definite purpose to be sure what we have in hand.

This is particularly the case with regard to distinction between attack of caterpillars of the Diamond-back Moth and those of the Turnip Sawfly, which were also present in the past season, notably near Ulceby, in Lincolnshire, and of which Mr. Frankish (of Limber, Ulceby), who is perfectly qualified to judge on the subject, wrote me (see note, p. 116) in reply to my inquiries, "It would be perfectly impossible for us, or any one, to separate the damage caused by the different caterpillars."

Remedies which would act easily and promptly on the Sawfly caterpillar would be very likely to have little or no effect on that of the Diamond-back; therefore, in order to be certain of what we are dealing with, I have given (with hardly any exceptions) only observations of contributors who sent me specimens;* and readers who wish to collate the notes given may easily do so by turning the pages so as to take the information given by the different observers under the various numbers of the "replies to inquiries in circular," and comparing these points (or those following and preceding with regard to accounts of first attack and ultimate results).

The great singularity of the attack consisted in the very sudden outburst of the infestation of an insect (which has long been known to be fairly common and abundant amongst Turnips and Cabbages) taking place *not* as might have been expected over inland and coastland indifferently, where these crops are generally grown, and their favourite weed plants found; but for the most part, and also most destructively and markedly, on a strip of coastland running the greater part of the length of the east seaboard of England and Scotland.

Difference of opinion appears to exist as to whether the infestation was home-bred or wind-borne from other countries. So far as is shown by the evidence given *it appears to me to have been wind-borne.*

By examination of the notes given under the head of "Appearance of Moths," pp. 155—157, it will be seen that great numbers of these were noticed at various localities, coincidently with observation of easterly winds, and that these having been observed at the shores or outside

* A few will also be found from contributors who appeared to be qualified to judge of what was present, and in the quotations I was permitted by favour of the Editor to make from the 'Alnwick Guardian' I have given the notes of the Northumbrian observers to *presence;* but I have given little or nothing broadscale, hearsay or reminiscence, for fear of *measures*, should they again be wanted in haste, not being found to stand the test.

the shores (and in various cases proved to be Diamond-backs by examination of specimens, or by the attack that followed their presence being of Diamond-back caterpillar), that the infestation spread inland.

It has been objected to this view that it is quite possible that the quantities of moths seen at Hartlepool, and at the Farne Islands, "came from neighbouring localities inland, attracted by the lights of the lighthouses." * It does not, however, appear to me that such could be the case, because on writing to Mr. John E. Robson, Fellow of the Entomological Society, who had recorded the Hartlepool attack with great care, he replied:—"Hartlepool lighthouse stands at the end of a promontory, but shines no light to land within many miles. Across the bay to the Cleveland Hills is the nearest, perhaps twelve miles away." Also on applying further for information on this matter to Mr. W. Belk, Engineer to the Port and Harbour Commissioners, Hartlepool, he favoured me by writing as follows:—"Relatively to moths, &c., appearing at this place on or about June the 24th, I am of your opinion that it would have been almost impossible that the lighthouse here could have caused the attraction, as the light is obscured one-third to the landward, and bright two-thirds to the sea." —W. B.

Also it is to be observed with regard to direction of progress, that Mr. Robson, though collecting (entomologically) inland on the 24th of June, noticed none of these moths at the locality Hezleden Dene, about one and a half miles from the coast, and on returning to Hartlepool found them in vast numbers. They disappeared almost entirely from Hartlepool in two or three days, and on the 26th were swarming at the inland locality Hezleden Dene, where they were known to be absent two days before. In regard to the Farnes (that the cloud of moths was driven by the N.E. wind), see line 2, p. 157; and we have also notes of the inland progress. And again, looking at coincidences further north it is of interest to note that the direction of the wind at Leith at 8 a.m. on twenty of the thirty days of June (as given in the daily weather report issued by the Meteorological Office), was E.; E.N.E., or N.E.; which prevalence may have borne much on the great amount of attack in Fifeshire, over which county and along which seaboard the N.E. wind would especially sweep.

The matter of the wherefrom of the pests is of so much importance practically, that it seems worth while to go into it so far as is possible. Amongst all the reports sent me there is no local evidence of the attack being home-bred. If such had been the case, it might on all general

* See Report of the Intelligence Department (Board of Agriculture) on "Attack of the Diamond-back Moth caterpillar in 1891," p. 20.

principles have been expected to be distributed over the country where its food-plants are mostly distributed. But if by any strange and unaccountable chance it had only been bred along the coast, it is almost impossible that the ravages of the myriads of caterpillars which must have forestalled the moths to which they presently developed should have escaped observation. It will also be seen by collating the "replies to inquiries" (Nos. 5 and 6), that for the most part there had been no particular weed observed, nor special presence of Charlock, nor difficulties in proper cultivation of the land.

The *crop food-plants*, whether field or garden, are of kinds to be found in all cultivated districts; and of *the weed food-plants*, as Charlock, Jack-by-the-hedge, Flix-weed, and others named *on good authority* as frequented by the pest, I only find two which occur (respectively), one ordinarily, one exceptionally, on the sea-shore.

Of these, one, the *Diplotaxis tenuifolia* (the narrow-leaved Wall Mustard or Wall Rocket), occurs in England by roadsides or on old walls; in Scotland it is recorded as not being found further north than Fifeshire, and occurring on the ballast hills at St. David's on the Firth of Forth. The other, the *Salsola kali*, or Saltwort, is found on sea-shores.*

In any case, however, as to this, it appears to me that such a very small proportion of the food-plants of which we have notes *on any sort of authority* are sea-side plants, that we have no reason here which explains a prevalence upon this one sole occasion on record of an extraordinary amount of outburst along our eastern coast.

At first the caterpillar ravage threatened to sweep all before it, and was variously reported as having entirely "destroyed" crops under observation; as "making havoc," "devastating the fields"; "brutes eating all in front of them"; "likely to be most disastrous to agriculturists"; causing destruction to hundreds of acres, &c., and naturally wide-spread uneasiness arose. This was enhanced by the destruction being so rapid. In this case, as with many other kinds of crop attack, the damage being little observable until "the brutes" have their eating powers well developed, the rapidity of the after progress is all the more remarkable; the myriads of nearly full grown eaters make way quickly.

The rapidity of the devastation was noticed by Mr. Garrett Taylor

* This is given by Dr. E. L. Taschenberg (in his 'Praktische Insekten-Kunde') as a food-plant of the Diamond-back caterpillar, and on his excellent authority I have repeated the statement in some of my publications; but I have not received any reports of caterpillar presence on this plant, and am informed by Mr. Atmore, of King's Lynn, that in his investigations on the shore where both Saltwort and Diamond-back Moths were present, that he has not seen that the caterpillar was present on the plant.—Ed.

(p. 120), as being as if a swarm of locusts had come. Near Carnoustie, Co. Forfar (p. 146), three days or less sufficed to wreck the leafage of all the plants in a ten-acre field. At Gunsgreen, Eyemouth, Berwickshire (p. 134), a promising crop was in ten days irrecoverably ruined, and similar damage reported on neighbouring farms.

Under these circumstances all that it appeared to me possible to do in reply to the many applications which were sent to me, officially or otherwise, was to place information immediately before all inquirers regarding the well-known history and habits of the insects, and also notes of such measures as had been found useful on previous, though not such urgent, emergencies. How far these or other means would have proved serviceable without the succeeding rainfalls, cannot be told; probably the use of the scufflers would have been beneficial, and the dressings been almost useless.

As it was, the following rains appear, by the various effects of the heavy downpour, to have been the saving of the crops. The rainfall was noted in many of the reports as not merely ordinary rain, but often as heavy, also as "very heavy rain and thunder showers"; and in one instance it is noted, "Heavy rains (1·73 in. and 2 in.) have done immense good, and caterpillar gone. Rain with wind is noted as especially beneficial."

Part of the benefit would be direct by lessening the amount of caterpillars, as these would be thrown open to action of the rain when accompanied by wind; part, as noted by various correspondents, by the sand and mud being dashed up and thus "soiling" the under side of the leaves, and making it rather difficult for the caterpillars to work, and a very large proportion of good would be done by the injured plants being thrown into growth again, and the food stores in the ground, or in the stimulating dressings, being made available by the moisture.

Amongst the dry dressings most especially mentioned as beneficial, nitrate of soda stands first, *not as killing the caterpillars*, but as throwing the plants into renewed growth. The following mixture was found useful at Edenthorpe (p. 113), 10 cwt. soot, 8 cwt. nitrate of soda, and 1 cwt. sulphate of ammonia, mixed well and sown broadcast by hand whilst the *dew* was on the leaves, at the rate of 1 cwt. per acre.

Nitrate of soda and salt have also been found useful. Proportions found serviceable by Mr. Garrett Taylor (p. 120), were about four stones per acre of each, sown by hand along the drills. Also (same page) Mr. Garrett Taylor noted, "I think the best remedy that has yet been found is a mixture of three-quarters soot and one-quarter lime, and sown on the plants."

Soot was found useful in clearing the caterpillars when thrown so

as to adhere to the under side of the leafage. At p. 125 the method is described as,—" Soot applied, August 6th, at the rate of 2 cwt. per acre, sown by hand one drill at a time, the sower stooping a little and keeping his hand low at the delivery." Here, however (as well as with other of the dry dressings), it is to be borne in mind that one great point of serviceableness is the effect on the plant as a manure; and where the caterpillars are only caused to fall, there may be need for mechanical measures to bury them (see above reference, p. 125).

Superphosphate is mentioned (slightly) as of use, and lime as not of use, though quicklime applied by hand when a strong wind was blowing along the drills, so that it was carried well to the under side of the leaves, was considered to do some good by interfering with the working of the caterpillars.

For spraying or wet dressings, four to six gallons of paraffin per acre, applied by the Strawsonizer, is mentioned by Mr. Garrett Taylor (p. 120) as having answered very well. A mixture of soft-soap and paraffin, in the proportion of 5 lbs. of the former and 5 pints of the latter to 100 gallons of water, was found to destroy the caterpillars on Cabbage leaves.

With regard to mechanical measures, " continued scuffling, or in any way brushing the land about, has been beneficial." On page 111, it is mentioned,—" The method I found to answer best, and the least cost, was using a thorn bough attached in front, and set so as to turn the leaves completely over; by so doing it broke the webs and let the caterpillars down, and the scuffler buried them." Page 117, " All the remedy I made use of was to keep going all the horse-hoes and scufflers I had all day long." Page 140 :—" Several farmers have put in boughs of trees in the scufflers. I put in my ploughs a good firm bundle of Wheat straw, bent down at the ends so as to rub the under part of the leaves without damaging them, as the boughs are apt to do." Whether, however, by means of ploughs, or horse-hoes, or scufflers, mechanical measures of disturbance suitable for making the caterpillars throw themselves down by their threads, and then burying them, have been found of much service. But in this attack the injury, when once it has reached the point at which it is noticeable, is carried on with such devastating rapidity that it is of vital importance to the crop to act at once. On this account (though it may reasonably be hoped that an attack which has only been recorded as troubling us to a serious widespread extent once before, and that about forty years ago, is not likely to be of frequent recurrence) it is to be borne in mind that implements and appliances to be found ready for use on every farm, and common farm manurial and chemical dressings such as are procurable, if not at hand, at the nearest town, are those to be most relied on.

Effects of the attack.—The amount of loss can hardly be reliably estimated, as this depends on many circumstances, besides what is calculable regarding direct deficiency of amount or of condition of the crop. But by collating the replies ("1") in answers to inquiries together, and also the preceding notes of observation of first attack, some idea will be gained of the power of the caterpillars for making rapid and complete work.

Taking just a few of the returns on farms or in districts along the line of ravage which show bad injury at various dates after about the middle of August, we find at a locality in Aberdeenshire (p. 151), 24 acres more or less destroyed; about 10 acres destroyed to the value of £100. Eyemouth, Berwickshire (p. 135), "In all my experience I never saw such a failure." Holbeach Marsh, Lincs. (p. 114), "I consider that 25 per cent. of the Swede crop in this district in acreage is entirely lost or gone, and that 25 per cent. of the whole crop is so injured as to be valueless." Corton, near Lowestoft, Suffolk (p. 121): —"The greater part of the crop was entirely destroyed." These few reports, taken from many, show the power for harm of the caterpillar, and every shade of difference in amount of harm, from slight attack, or sound *bulb-forming* recovery, down to complete clearance, will be found in the notes.

The same differences will be found in such few reports as were contributed of ultimate condition, or of state at the end of the year. They are (as the case may be) of plentiful crop of good bulbs,—this from personal examination by reporter,—or of bulbs lessened in size by attack, or even (see top lines of p. 136, and third and fourth lines from foot p. 148) of very severe loss, or complete failure; this last, however, appears to have been quite exceptional, so far as I can judge from reports sent to myself.

One great feature of the recovering crop was the enormous luxuriance of leafage, often leading to a hope that the bulbing beneath would be satisfactory; another the extra amount of tops; and in one case (p. 126) the altered form of the bulb is mentioned, "the Swedes seem to have been more to neck as well as leaf than usual."

Probably the remarks given under reply to inquiry (4), p. 138, and the remarks on the following page (139), as to effect of unfavourable weather on recovery of bulb-forming powers of the crop, give as good a general sketch of the matter as can be put in a few words.

The attack has not been so utterly disastrous as it was feared might be the case from the severe injuries following on the first observation of its presence; but it has been very mischievous, and so peculiar in many points, that taking it as a whole I am not aware of more than one somewhat similar instance having been *trustworthily* recorded as occurring in this country. There is nothing unexampled in the

appearance of vast swarms of Lepidoptera (*i. e.*, of moths and butterflies) which have flown or been wind-borne over sea and wide expanse of land. No better example of this is probably on record here than the enormous appearance of the "Silver Y," or Beet Moth (the *Plusia gamma*), and the Painted Lady Butterfly (*Vanessa cardui*), of which one great detachment crossed the Mediterranean from Africa to Valencia, and another crossed to Sicily in 1879. The progress of these across Europe was noted, especially in Saxony, where the Beet Moth caterpillar ravage reduced the yield of the infested Beet from 9 to 10 tons per acre down to only 3 tons; the first appearance on our south coast being noticed on June 10th.*

There is also a record of an exceedingly similar attack to that of the past season given by Mr. Wm. Marshall in the Transactions of the Royal Society for 1783, vol. lxxiii., p. 217. In this case the attack was of Turnip Sawflies, and the locality the Norfolk coast. The insects were seen out at sea, were found in vast numbers on the coast, and from thence proceeded inland. The young caterpillars were found shortly after present on the Turnip leafage, and the destruction "was not confined to the eastern coast, but spread more or less to the centre of the county."† It is worth observation that presence of caterpillars of Turnip Sawfly was found together with that of Diamond-back Moth caterpillars in one district during our last year's attack (see p. 116).

So far, however, as I am aware the experience of last year, *taking all the points together*, was unexampled here, and therefore, so far as in me lay, I have used my very best endeavours to secure a permanent record, with authorities so fully given, that we may be sure of all details, or may verify any doubtful point by reference, and I offer my hearty thanks to all my correspondents for the care and patience with which they were good enough to reply, sometimes again and again, to my repeated inquiries.

* See pp. 4, 5 of my 'Report on Injurious Insects' for 1879, with details and date of progress of the swarms placed in my hands by Mr. E. A. Fitch, Hon. Sec. of the Entomological Society of London.

† As many (like myself) have not the original paper to refer to, it may be mentioned that extracts, and a few remarks (especially on the perfect possibility of the swarms coming on the wing), will be found in Curtis's 'Farm Insects,' pp. 38—40; and much of the paper is also given by Edward Newman, F.L.S., &c., in Appendix B to his small volume entitled 'Rusticus.'

OX.

Ox Warble. *Hypoderma bovis*, De Geer.

2 1 3

1, Ox Warble Fly; 2, maggot; 3, chrysalis.

The life-history of the Warble Fly, and information regarding measures which have been found to be of reliable service in lessening the heavy losses caused by uncared for presence of its maggots in the hides of our cattle, have now been so repeatedly entered on in these Reports since the year 1884, that we appear to have these parts of the matter as thoroughly in hand as can be needed for practical purposes.

1st. *We have the history of the attack, and of methods of prevention and remedy*, from scientific as well as practical observations of veterinary surgeons, farmers, and cattle-owners, to which relatively to the attack itself I have added the minutest observations I could myself make regarding the development of the maggot, and also of the Warble, from what could be learnt from sections of the hide whilst the maggot was still in what might be described as a microscopic stage, to the conditions observable in the newly flayed hide, or on the carcase from which the hide had been taken.

2nd. *With regard to losses*, we have the testimony of great numbers of those most personally interested in the matter, accompanied by their well-known names, regarding the mischief and losses occurring in all stages of the attack, from the preliminary galloping to loss on hides and carcases; and in my Report for 1888, I give estimates or calculations from many of our leading butchers, hide or cattle firms and associations of England and Scotland, showing the severity of the losses incurred, which, from accompanying trade tables, may be calculated minutely even down to numbers of hides in the special classes, which were "outclassed" in one of our large markets in the year, together with the depreciation in value per hide, and also depreciation per pound.

3rd. *The pressing need of remedy of this state of things* is not only shown by the records of public and private loss, but borne witness to authoritatively in various ways, as by the special arrangements made for exhibition of warbled hides, and dissemination of instruction

regarding measures of prevention and remedy given at the shows of our own Royal Agricultural Society; also by the similar attention drawn to the subject in various localities yearly by other societies or large firms connected with the hide and cattle trade, and notably the attention given at the show of the "Royal Dublin" Society in the past winter.

Under these circumstances it would seem to be but waste of space to go over these points again; I add, however, the following note sent me by Mr. W. Bailey, Headmaster of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, to show how (for all practical purposes) this wasteful infestation may be got rid of throughout a district by no more troublesome or expensive measures than the voluntary work of some of the boys of a country school, under instruction as to what was to be done, and with the willing permission of the farmers of the neighbourhood to allow the lads access to their cattle.

My first report of their work was in 1885 (warbles being then, as previously described, as plentiful as blackberries). It was at first begun under the suggestion and advice of Mr. Bailey the Headmaster, with perhaps some amount of co-operation from myself, and was continued, from the benefit accruing to the cattle, and thence to their owners, with such success, that on Dec. 6th, 1887, an account of their work was read before a Committee at the Royal Agricultural Society, and directed by Council to be published.

The work has since gone on so satisfactorily, that in the past year instead of giving me his customary detailed report Mr. Bailey wrote as follows:—"Although I again granted the boys a roving commission, and no want of diligence was shown in their search, I am glad to tell you that an exceedingly small number of maggots has been discovered. The highest number brought in by any one boy was 23 this year. You will remember that a very few years ago they were as plentiful as blackberries, and that one boy alone (F. Ravenscroft) destroyed nearly 300.

"I believe that now all the farmers in this district very carefully examine their stock for warble maggots, and that although we may not be able to stamp this pest out *completely*, as long as cattle are bought in fairs at some distance from us, it will always be well kept down."

The great obstacle in the way of advance in stamping out this attack is IGNORANCE. It takes a long time to undermine old prejudices, particularly when these agree conveniently with carelessness, idleness, and also with getting off damaged beasts at the price of good ones.

We need to get plain information so well spread, that it may be available for the cattle-men,—as well as for the cattle-owners, and also for working butchers,—that they may know the loss they are likely

to suffer from "licked beef" on the carcase of a beast of which the hide is badly warbled. In the present increased attention which is being given to agricultural instruction in rural districts, it would be highly beneficial if this subject could be brought forward, and as before, I should be only too happy to forward copies of my two leaflets respectively on Warble Fly and Licked Beef gratuitously to all applicants who wish for them for practical purposes. Of these the first describes the nature of the attack, with the methods of prevention and remedy which have been found serviceable. Of this about one hundred and twenty-six thousand have been already circulated. The other gives more special information on the nature of the condition of the carcase known as "Licked Beef" or Jelly, as found beneath badly warbled hide. Both leaflets are fully illustrated.

NOTE.

Tare, *Cecidomyia*. At p. 54, reference is given to a paper on Tare Cecids for figure of a *Cecidomyia* showing the "anchor process," or "breast-bone." I have not, however, succeeded in rearing any specimens of the perfect insect (*i. e.*, the *Cecidomyia* or Gnat Midge) from the great number of Tare Cecid maggots which were placed in my hands last summer. Therefore, as I cannot as yet identify the species, and do not like to give an incomplete observation, the figure below is substituted.

This figure of the *Cecidomyia leguminicola*, Lintner, or American Clover-seed Midge, which is sometimes found in England, will give the reader a correct view of the usual form of the maggot of *Cecidomyiæ*, with the anchor process beneath the head end; the anchor process still more magnified, with, in this instance (as in that of the Hop Strig maggot), a bifid extremity; and also a figure of the two-winged Midge-gnat.

Cecidomyia leguminicola.

1, Clover-seed Midge; 2, maggot; 3, portion of female antenna, with minute hairs figured on lowest joint; 4, portion of male antenna; after Professor Riley; 5, anchor process; after Dr. Lintner; all magnified; 6, anchor process, figured from English specimens, also magnified, by Ed. Nat. length of maggot about one-twelfth of an inch.

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