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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS

AND
COMMON FARM PESTS

DURING THE YEAR 1889,

WITH METHODS OF
PREVENTION AND REMEDY.

THIRTEENTH REPORT.

BY

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P R E F A C E .

DURING 1889 enquiries were sent me regarding about seventy (or upwards of seventy) kinds of insect attack, injurious for the most part to farm crops or stock, or to matters connected with farm produce. Of these the most destructive, perhaps, were the serious ravages of the Orchard Moth-caterpillars, in various of our chief fruit-growing counties, in the early summer.

The following list, however, of injurious insects regarding which reference was made will show that most of our common kinds of farm pests were present. In some instances the loss caused was slight, but in some the attack was both prevalent and destructive in many localities, and the correspondence regarding it extended over many weeks. Requisite details will be found in the following pages, but I give here just a list of the more important of the attacks (under their common English names), as it is of some interest to be able to see at a glance the variety and number of farm-insect attacks calling for attention in an average year of infestation.

Taking Corn pests first, attacks were reported of Frit Fly, Gout or Ribbon-footed Corn Fly, Hessian Fly, Saddle Fly, and Eelworms. Wireworm and Daddy Longlegs grubs were as a matter of course present, but, as they are attendant upon Corn as well as many other crops, may be as well entered under this heading.

Clover-stem sickness caused by Eelworms gave opportunity for first-rate contribution of methods of prevention and remedy; besides these, there were present Clover Weevils, Millepedes, and a kind of "Red Maggot," which requires further investigation. Carrot Fly, Onion Fly, Bean Aphis and Bean Weevils, Hop Aphis, Mustard Beetles, and the great Potato-leafage feeding

caterpillar of the Death's-head Moth were also reported. Mangolds suffered in various places from the Mangold-leaf Maggot, and an Aphis (Plant Louse) was also present; and on Turnips or Cabbage respectively the most notable pests recorded were *the* "Turnip grub," the Turnip Diamond-back Moth, the Turnip "Mud-beetle, and the maggots of Cabbage-root Flies.

Amongst Orchard Moth-attack we had those of the Winter (or Evesham), the Mottled Umber, and the March Moths, all destructive by means of their Looper-caterpillars; the Lackey, and the Small Ermine Moths' web-nest makers; the Figure of 8 Moth, with its "blue-head" caterpillars, and the Codlin Moth; also the little Eye-spotted Bud Moth, and the Pith Moths, besides other kinds not so particularly noticed. The very injurious Apple-blossom Weevil also occurred, and the Woolly Apple Aphis (commonly known as "American blight") was also the subject of enquiry.

Pear as usual suffered from Sawfly,—a very destructive attack which might most easily be prevented,—and a few less important infestations; Plum, from Aphides and the newly-observed Shot-borer Beetles, whose ravages need most careful attention. On Currants the Gall-mite continues to cause great loss to growers; and the White Woolly Currant Scale, which happily can be easily got rid of, was first recorded as present in England in the past year (1889). Gooseberry caterpillars (which, whether of Moth or Sawfly, might be much lessened or quite got rid of by proved and simple treatment) were present, and Gooseberry Scale was enquired about.

The caterpillars of the great Goat Moth and of the Wood Leopard Moth (destructive to the solid wood of fruit- as well as timber-trees) were also sent, and, without entering in tedious detail on forest infestations, so also were notes and specimens of attack to Pine, Oak, Beech, Poplar, and Willow.

Amongst Stock-insects, Ox Warble Fly is being well attended to; enquiry has also been made about Ox Gad Fly and Horse Warble Fly, much about Horse Bot Fly, and some also about Sheep-nostril Maggot.

Besides these infestations, such as those of *Acari*, or mites, which sometimes make a haystack appear almost alive by their masses, Ants, Earwigs, and insects infesting farm produce

or the timber of farm-buildings have come under notice, as likewise the sometimes serious injuries to crops in field or garden from pests, such as Slugs, Snails, Millepedes or False Wireworms, and Wood-lice.

The five kinds of insects noticed which had either not been recorded as present in England until 1889, or been only recently observed, were the Plum "Shot-borer" Beetles (*Xyleborus dispar*); the "White Woolly Currant Scale" (*Pulvinaria ribesiae*); the "Turnip Mud-beetle" (*Helophorus rugosus*); the Saddle Fly (a *Cecidomyia* agreeing in such points as could be traced previous to development of the perfect insect with the habits of the *Diplosis equestris*); and the Flour Moth (*Ephestia Kuhnella*), an infestation calling for the promptest attention as a perfect scourge in Steam Wheat Flour Mills, and wherever it may gain possession in town or farm wheat flour or meal stores.

Some of our common Corn pests were remarkably little reported on in the past year (speaking, of course, of observations sent to myself), as Corn Sawfly, Corn Aphis, and the Red Maggot of the Wheat Midge; and Beet Carrion Beetle, which was first recorded as injurious to Mangolds in England in 1888, was not noticed in 1889.

Hessian Fly was reported to me reliably from about nine English localities, but of these fully half the notices only referred to it as present on special farms; and though reported as very prevalent, that is, as occurring on a large proportion of the straws of infested fields, yet it appeared, both from specimens and information sent, that the infestation often amounted to no more than the presence of one, or sometimes two maggots on the attacked straws. The damage was noticed in several instances as being slight, and the highest estimates of loss sent me were respectively of "several bushels" per acre on one 53-acre field, and of an amount not exceeding four per cent. per acre in any case on the farm of the Royal Agricultural College, Cirencester.

During the past year sound advance has been made in general attention to reasonable and practicable methods of prevention (or of lessening amount of loss from ravages of insects), based on plain knowledge of their habits, and of meeting the requisite points, by agricultural measures, good for the crop, as well as injurious to the insect-pest.

In some cases, of course, infestation can only be got rid of by measures specially directed to clear away the special trouble; but for the most part it is the large proportion of common farm measures which may be brought to bear on common farm pests (if only what is wanted is known to the agriculturist) of which the details are the most valuable for distribution.

In submitting this my 13th Report firstly to those by whose observations most of the information contained in its pages has been contributed, I beg to offer my most hearty thanks for their assistance, including in this some of almost all the different branches of our great agricultural body, whether interested in crop or stock; and especially (for the investigation was for myself a most difficult task) the many who kindly aided me in the Warble investigation, and are still giving their influence most serviceably in the work of stamping out this most unnecessary pest.

I have also to offer my best thanks to the Agricultural and general Press for the courtesy with which they give such efficient aid as could be gained in no other way, to my endeavours to be of some service in insect prevention.

Beyond this country my thanks are also due to many correspondents, and especially to Mr. J. Fletcher, Dominion Entomologist, of Canada, for frequent and valuable co-operation most cordially given, and similarly to Mr. Frazer S. Crawford, Government Inspector under the Vine, Fruit, and Vegetables Protection Act, Adelaide, S. Australia; and to Mr. Albert Molineux, Sec. of Bureau of Agriculture, S. Australia.

I am also indebted for much useful communication to Prof. C. V. Riley, the eminent Entomologist of the Department of Agriculture, U.S.A.; and to Dr. J. A. Lintner, Entomologist of New York State, I am also indebted for courteous and valuable communication. Amongst European correspondents I must especially record my obligation to Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, for his constant skilled co-operation, especially regarding the important and difficult subject of *Nematode* investigation, by which he has given us much very practical benefit regarding prevention of damage from Eelworms.

Besides the benefit of correspondence, I am also under obligation for donations of many valuable publications sent me

by their authors, a helpful kindness which I only regret I am not able to reciprocate more fully.

In the identifications, or confirmation of my own identifications, of some of the insects mentioned in this Report which were previously little known here, or had not come under my notice previously, I have availed myself of the skilled aid of Mr. Oliver E. Janson, F.E.S., Perth Road, London, N., who has aided me greatly in my researches.

At home as ever, I am always assisted by the collegueship of my sister, Miss G. E. Ormerod, and being able to benefit by the assistance of my lady secretary and amanuensis, Mrs. Hartwell, aids me much also.

The figures given in this Report are from the following sources. I beg to acknowledge with thanks permission from Messrs. Blackie, Glasgow, to use electros of the figures given at pp. 14, 16, 19, 22, and 101.

From the 'Gardeners' Chronicle' series, those at pp. 76, 77, and 84. The figures at pp. 56, 57, and 79, are from Newman's 'British Moths,' with the exception of the Wingless Moth (walking) and the Looper Caterpillar respectively in the first two figures, which are from the 'Praktische Insekten Kunde' of Dr. E. L. Taschenberg, and the twig with moth-eggs in the third, which was drawn for this Report.

Fig. p. 81 is from 'Insects Injurious to Fruit,' by Prof. W. Saunders, Canada.

The remaining twenty-four wood-engravings have been almost entirely drawn from life for these Reports, in some portion by myself, but usually by Mr. Horace Knight, artist to Messrs. West, Newman & Co., Hatton Garden. Of these, the figures (eight in all) of the *Chlorops*-infested Barley-plant; and the Barley-stem, with its saddles; the Wheat-bulb Fly; the two figures of the White Woolly Scale, including the Scale-infested spray, from a photo. by Mr. T. P. Newman; the little Apple-twigs; and the Turnip "Mud-beetle," are new illustrations drawn for the present Report.

For the large plate of *Tylenchus devastatrix* I am indebted to the courtesy of Dr. J. Ritzema Bos in allowing me to have copies made of some of his own excellent drawings from life, and also revising the plate himself before publication.

It remains to me now to express the hope that the assistance so long given to me in agricultural insect researches will still be kindly continued in the coming season, and that I may be enabled to look forward to again placing serviceable information entrusted to me before my contributors, and those who encourage the work of prevention of insect-ravage by their approval.

ELEANOR A. ORMEROD,

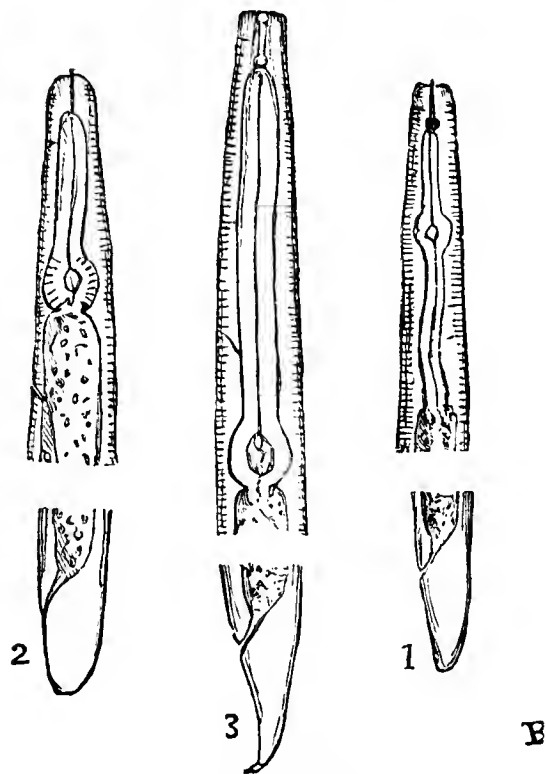
*Consulting Entomologist of the Royal Agricultural
Society of England.*

TORRINGTON HOUSE, ST. ALBAN'S,
March, 1890.

NOTES OF OBSERVATIONS
 OF
INJURIOUS INSECTS
 AND
 COMMON CROP PESTS

DURING 1889.

CLOVER.



ANGUILLULIDÆ.*

1, *Tylenchus obtusus*; 2, *Aphelenchus avenae*; 3, *Plectus granulatus*,
 The natural size of above is microscopic.

DURING the spring of last season many specimens were forwarded to me, from different localities, of diseased, and in some cases dying, Clover-plants, together with enquiries as to the cause of the evil. The plants were usually much alike in condition, that is, more or less decaying towards the centre, and sometimes down the main root-stem;

* Reduced from figures by Dr. H. Charlton Bastian, F.R.S., &c., given in Plate X. of his "Monograph on the *Anguillulidæ*," published in vol. xxv. of the 'Transactions of the Linnean Society.'

the growth of the shoots in some cases deformed, that is, shorter and thicker than the natural form, and the buds also having a swelled appearance; and the plant, after being unpacked, decaying further, and becoming mouldy very rapidly. In the earth round the roots I found *Sitona* larvæ, that is, the maggots of the small beetles known as Clover, Pea, and Bean Weevils—Millepedes or False Wireworms; and in almost all cases, at least in the earlier part of the investigation, there was also presence of a small orange or reddish footless maggot, very like the well-known "Red Maggot" of Wheat and Barley, and (like it) the larva of a *Cecidomyia*, or Gnat Midge.

What mischief these various creatures and some other kinds also present were *or* might be doing is considered further on; but the great injury, wherever we could run it clearly to its origin, was the kind of Clover "stem-sickness" caused by Eelworms, and in the notes immediately following I give as complete an account as I am able of the results of investigation of specimens sent me from the experimental ground of the Royal Agricultural Society at Woburn, and also from the experimental ground of Sir John Lawes at Rothamstead, Herts; in the latter case with notes appended of success (or otherwise) of applications made to check the attack.

Early in April specimens of Clover were sent me from Woburn by Mr. F. E. Fraser; these were sickly-looking, and partly dead, and on examination showed symptoms of Eelworm presence, but no obvious infestation at the time. From the decaying and mouldy state of the plants I thought it possible that the *Peronospora trifoliorum*, D. By., to which one form of Clover "sickness" is attributed, might be present; and to ascertain surely how this might be, I forwarded specimens to Mr. Worthington G. Smith, Dunstable, who has made the Fungi his special study, and was favoured by him on April 7th with the following reply:—

"I have looked carefully over the Clover-plants, and I cannot see a trace of any parasitic fungus. The white mildew is only *Penicillium*, growing on places injured by disease; the plants on my table are now covered with this mould. *Peronospora trifoliorum* forms *very distinct, grey, woolly patches*.

"The general appearance of your plants reminds me at once of the work of *Nematodes*—the leaves, as well as the softened semi-rotten rootstock. As you well know, *Nematodes* sometimes go away from decaying plants; after a certain stage they leave the host-plant, and go into the ground. They are sometimes very scarce in plants which have been undoubtedly destroyed by them."—W. G. S.

As this is a well-known fact, and it was most desirable to learn with certainty from a known expert in study of *Nematodes* what was going on, about a fortnight later at my request Mr. Fraser forwarded

fresh specimens to Dr. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, who was good enough to examine and report to me on April 18th as follows:—

“Yesterday I received from Mr. Francis E. Fraser (Woburn) a packet of much-diseased Clover-plants from the experimental ground of the Agricultural Society, and I have hastened to examine them. The stalks and branches were shorter and thicker than in the normal Clover plants; the buds particularly were much thicker, and some stalks and branches began to decay, or were dying. I found in these plants larvæ and adult nematoid worms belonging doubtlessly to the species *Tylenchus devastatrix*. In the buds I found them in considerable numbers. In the dying parts of the Clover-plants I found also *Tylenchus devastatrix*, but still some other nematoid worms, belonging to the genera *Diplogaster*, *Cephalobus*, and *Rhabditis*. But their number was small.”—J. R. B.

This identification of presence of the *Tylenchus devastatrix* is of special interest in connection with previous observations of the pest in Clover at Woburn. In the account published in 1889 of the Woburn experiments, it is noted at p. 14, relatively to the “Experiments with Clover,” that:—

“. . . Clover-sickness appeared in the plots in 1887; as it appeared in the various plots, there was no evidence that the manures employed had any relation whatever to it. The presence of *Tylenchus devastatrix*, which Mr. Whitehead and Miss Ormerod had found attacking sick Clovers, confirmed their opinion that this *nematoid* was the cause of the disease.

“The plots were dug up and re-sown in 1888, Trefoil and Lucerne taking the places of one of the Red and one of the White Clovers. Again Clover-sickness appeared, destroying most of the plants. On examination it was found that most of the ‘sick’ plants were all injured by the attacks of the same minute worm.”

“The plots have been dug up, and re-sown this year with similar seeds to those employed in 1888.”*

With regard to my special record of the above.—On July 8th, 1887, Mr. F. E. Fraser forwarded me for examination from the experimental farm, Woburn, specimens of diseased Clover, which proved to be excellent examples of the peculiar form of diseased growth which may be looked on as a characteristic of “stem-sickness,” that is, of the diseased state of Clover caused by presence of *Tylenchus devastatrix*.

Some of the stems with flowering heads were still to be found, but also there were a large number of short barren shoots, about an inch long, oval in shape, and with the distorted growth of leaves then merely

* ‘Object, Plans, and Results of the Woburn Experiments published by the Royal Agricultural Society of England,’ 1889.

forming an imbricated, or "tile-like," exterior. These shoots were placed closely together, apparently from the growth of each shoot having been stopped.

They varied in number; sometimes as many as five grew on an inch length of stem, one at the extremity and two at each side below, so as to form together a flat, fan-like mass. I did not find they grew round the central stem. They were not all similar in form of diseased growth, but were commonly irregularly, and oval- (or somewhat bulb-) shaped; but sometimes they were much prolonged, so as to resemble what is known as a "duck-necked" Onion in shape, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base.

In some instances the short, brown, deformed shoots had a little bit of deformed shoot or of leaf-growth proceeding from it. One of the shoots, which was merely swollen, not altogether shortened by disease, on being opened, proved hollow near the base, with decayed matter within, and also palish brown powdery or rather damp granular matter, and on placing this under a one-inch object-glass it proved to be swarming with *Anguillulidæ*, or "Eelworms."

Under a quarter-inch object-glass I clearly distinguished in some of these the presence of a *mouth-spear with a bulbous base*. I also found *Anguillulidæ* in the short (then), brown, somewhat bulbous-like shoots in the perishing matter in the centre of the short, somewhat scale-like leaves.

In order to be absolutely certain of the nature of these Eelworms, I forwarded specimens of the infested Clover-plants to the Netherlands for the skilled examination of Dr. J. G. de Man, of Middleburg, and of Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen; and from them I received the following definite statements of the Eelworms present being the *Tylenchus devastatrix*, and of these being the cause of the diseased condition.

Dr. de Man reported:—"I have examined the Clover-plants that you have sent me, and most plants, if not all, were found to be infested by numerous *Tylenchus devastatrix*, so that the occurrence of this dangerous worm ought to be regarded as the cause of the disease."—J. G. de Man.

Dr. J. Ritzema Bos wrote me:—"In the 'Clover-sick' plants I have found the deformations you so correctly describe, and I found *T. devastatrix* in them."—J. R. B.

The above observations show the presence of the Clover "stem-sickness" caused by *T. devastatrix* to have continued so as to be recorded at intervals during the period named, and also (so far as one series of observations can show) points to the peculiar form of diseased growth—being much more developed in the growing season than (in

the specimens inspected) when the winter was passing away. The above gives the history of the Woburn attack, so far as I know it up to present date.

With regard to that at Rothamstead.—About the end of March and onwards I had much communication with Mr. John Willis, of Harpenden, regarding Clover-disease in the neighbourhood of Harpenden. In the plants more particularly submitted to me for examination from a field of Red Clover belonging to Sir John Lawes at Rothamstead, the attack was similar, apparently, to that mentioned on p. 4 as occurring at Woburn; and though various kinds of Weevil, and of Gnat-midge Maggots, Millepedes, &c., were present in the earth at the roots, there did not appear to me to be any reason to consider that the diseased state of the crop was caused by anything but (as at Woburn) by the *Tylenchus devastatrix*.

Some of these plants I also forwarded to Dr. Ritzema Bos, and on April 22nd, that is, four days after I had been favoured by him with the report on the Woburn specimens, he reported on these from Rothamstead to me as follows:—

“I have examined your Clover-plants from the fields of Sir John Lawes at Rothamstead, and I have found in them the same organisms as in those sent to me by Mr. Francis E. Fraser. I saw the buds and the branches swollen up, but the latter remained very short, and the leaves remained little. In some of the plants sent by you, the roots were dying, but without any attack by insects, worms, or other animalcules at the outside of the roots. In some other plants the roots remained healthy, were recovering, and putting out little shoots. In the swollen shoots and buds I found *Tylenchus devastatrix* in large numbers, and also their eggs; in the dying parts also some *Rhabditis* and *Cephalobus* species, but these in small numbers.”

“Without any doubt, the Clover-sickness of the plants you were good enough to address to me is caused by *Tylenchus devastatrix*: I conclude this from the large number of *Tylenchus* which I found in the diseased plants, and from the general appearance of the Clover-plants.”—J. R. B.

It is not at all unusual to find various kinds of Eelworms feeding in the withering or decaying parts of plants suffering from *Tylenchus* attack, although these other species, as far as observations go at present, *never* cause the Clover “stem-sickness.”

One main point of distinction of these *Nematodes*, or “thread-worms,” is the form of the *œsophagus*, or gullet, by which food is sucked into the wormlet. In some cases the mouth-cavity is furnished with a long process, called a spear, and in the *Tylenchi* this spear is placed on a trilobed bulbous base. The figure at the head of this paper gives some idea of a few of the forms of the mouth-extremity of different kinds of *Nematodes*.

For practical purposes, the deformed growth of the "stem-sick" Clover is quite enough to show the nature of the attack, but as a guide to what is to be searched for in cases where this altered growth may not be as yet sufficiently advanced to show the cause of the "sickness," I give the accompanying *magnified figures*, which I am permitted to make use of by the courtesy of Dr. J. Ritzema Bos.* These figures give all requisite details for microscopic identification.

EXPLANATION OF PLATE.

FIG. 1. *Tylenchus devastatrix*, female, taken from an Onion plant; magnified 200 times.

a, spear; *b*, first muscular swelling of the œsophagus; *c*, second œsophageal ring; *d, e*, intestine, properly so called; *e, f*, rectum; *f*, anal opening; *g*, excretory pore (orifice of the lateral vessel); *h*, commencement of the ovary; *i*, ovule, with nuclei (or germs), not fertilized; *k*, first half of the oviduct (tube), with spermatozoids; *l*, second half of the oviduct, with glands in the wall; *m*, anterior portion of the uterus, containing a fertilized egg; *n*, sac, with closed extremity, second portion of uterus; *o*, vulva.

FIG. 2. *Tylenchus devastatrix*, male, taken from an Onion plant; magnified 200 times.

For *a, b, c, d, e*, and *g*, see explanation of preceding figure; *f*, cloacal opening; *h*, commencement of the testis; *i*, mother-cells of the spermatozoids (Spermatoblastes); *k*, cells further divided, forming spermatozoids; *l*, vas deferens; *m*, spicule; *n*, accessory piece; *o*, purse.

FIG. 3. Anterior portion of a *Tylenchus devastatrix*, not fully developed, taken from an Onion plant; magnified 440 times.

For *a, b, c*, and *d*, see explanation of fig. 1. In front of the spear (*a*) is shown the labial region, and lower, at the base of the spear, the *musculi protractorii* leading forwards, and the *musculi retractorii* leading backwards. The half of the œsophagus in advance of the first bulb, or muscular swelling (*b*), has a straight direction; the half which extends from the first to the second muscular swelling is waved. In the second bulb nuclei are visible. Near (*d*) the intestine begins; in the wall of this the separate cells are not distinguishable, because of the presence of the numerous drops, which refract the light strongly.

FIG. 4. Anterior portion of a *Tylenchus devastatrix*, taken from a Wheat-plant; magnified 440 times.

FIG. 5. Eelworms from Hyacinth, dried and rolled together.

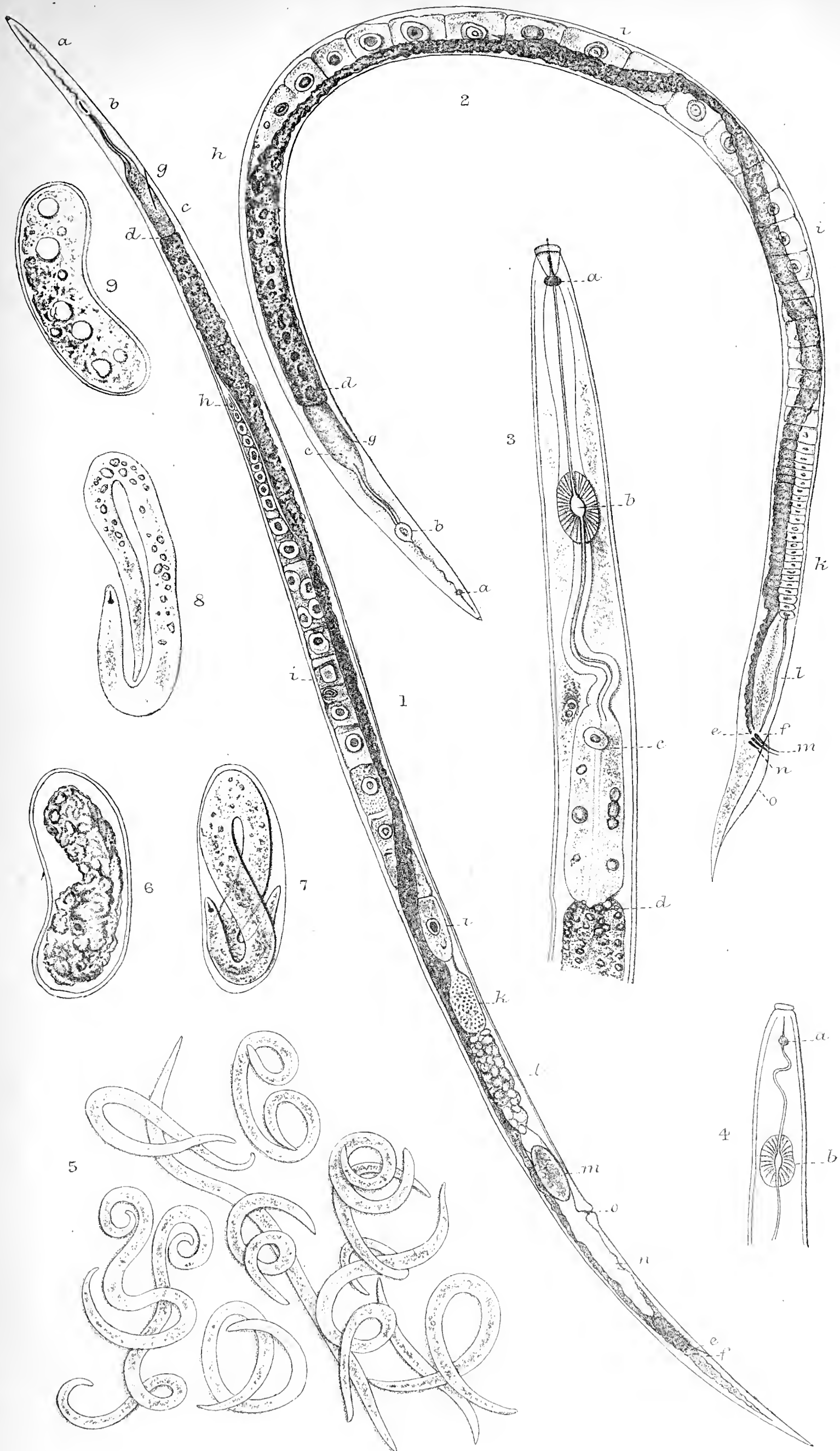
FIGS. 6 & 7. Eggs of *T. devastatrix*, showing an early and late stage of formation of the embryo.

FIG. 8. The young wormlet (*T. devastatrix*) newly emerged from the egg.

FIG. 9. Egg of *T. devastatrix* before segmentation of protoplasm.

The above figures are all given enormously magnified. For some further notes of measurement, see p. 7.

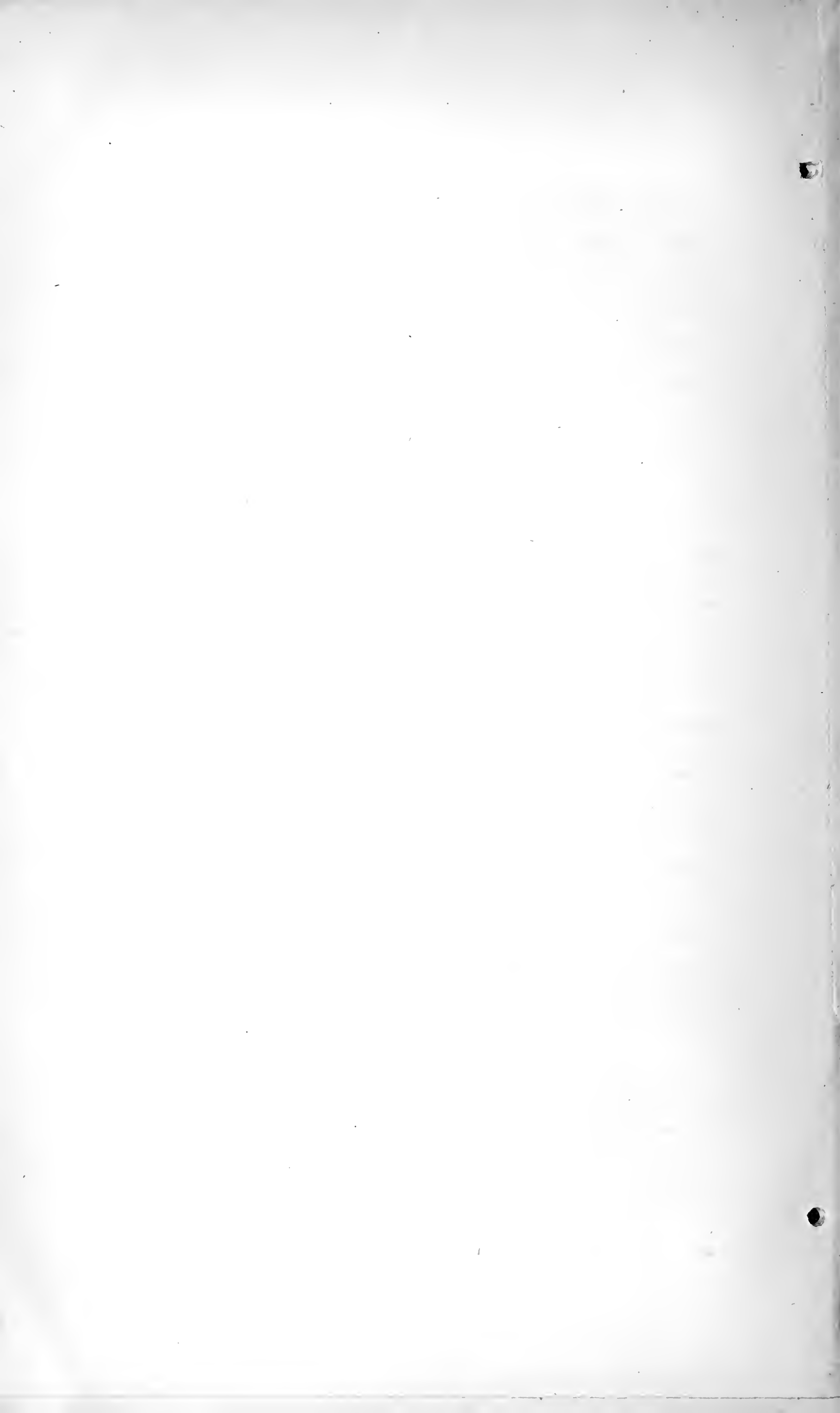
* See Plates I. and II. in 'L'Anguillule de la tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. a l'Institut Agricole de l'État à Wageningen.



D. J. Ritzema Bos. ad nat. del.

West Newman lith.

Tylenchus devastatrix Kuhn.



The life dimensions noted for me by Dr. J. G. de Man in 1887, from measurement of specimens of *T. devastatrix* taken from stem-sick Clover, sent me from Kent, are as follows:—

Dr. de Man reported to me:—“I found that both the male and female attain to a length of 1.5 mm.; the tail measures in both one-fifteenth to one-sixteenth of the whole length; the œsophagus measures one-sixth to one-seventh of the whole length, and the spear in the head has a length of 0.013 mm. All these dimensions perfectly agree with the original description of Kuhn, so that these specimens positively are representatives of *T. devastatrix*. . . . The eggs of *T. devastatrix* are oval, and are 0.07 to 0.08 mm. long.”—J. G. de Man.

Males, females, larvæ, and eggs may be found together in the infested shoots. One millimetre being the 25th part of an inch, it will therefore be seen by the above note that the largest size of these *Tylenchi* is little above the 25th part of an inch in length, and that the “mouth-spear,” one of the portions that is necessary to make out clearly for identification of species, is only visible at all when enormously magnified. Under these circumstances, although I *examine* carefully for Eelworm presence, I have never yet reported *Tylenchus devastatrix* as quite *certainly* present, without first submitting my identification to one of the two distinguished experts, Dr. de Man or Dr. Ritzema Bos.

Distribution. — We have, in the course of the three years in which this attack has been under special observation, found it in widely-separated localities, so that it may be considered as generally distributed. I have received specimens, in Clover suffering from “stem-sickness,” from Playford, near Ipswich; from a locality in Kent, “on a coomby soil between the Chalk and the Greensand”; from Woburn, in Bedfordshire; and Rothamstead, Herts (as above mentioned); and from Uphall, Linlithgowshire, in Scotland. Other specimens of attack were sent me, in which I found the deformed or “stem-sick” growth, and also the *Tylenchus* with spear placed on a bulbous base; but as it is of considerable importance to record the Clover-attack without any possibility of mistake, I have only in this paper noticed the cases in which I had the benefit of skilled identification, or confirmation of my own observations.

Method of Prevention and Remedy.

Tylenchus devastatrix, or the “Stem Eelworm,” as it may conveniently be called, infests many kinds of crop and weed plants, and can pass from one to the other; consequently *rotation of crops* is one point to be considered in the matter of prevention.

Some of the field crops most subject to attack are Oats, Rye, Clover, Teazels, and Buckwheat; Onions also are very liable to it, and there is also a Potato-sickness caused by *Tylenchus devastatrix*. This new form of attack was observed by Dr. Kuhn in Germany, and also by Dr.

Ritzema Bos in 1889; and as a threadworm or *Nematode*-attack has appeared in Potatoes in the United States, it is probable that this same Eelworm is causing it, and that we shall before long find it here.*

From minute experiment it has been found that by sowing seed of plants liable to infestation on earth in which fragments were buried of plants containing the "Stem Eelworm," that the young plants coming up from this seed presently were infested similarly. Thus we prove the identity of the kind which causes the attack. Dr. Ritzema Bos (to mention one of his many experiments) obtained Tulip-rooted Oats by sowing Oats on sand mixed with decaying "Clover-sick" plants and diseased Onions; Rye sown over infested Teazel-heads was found by Dr. Kuhn to become infested; I have myself similarly caused infestation in the Turnip, although this is not a plant considered to be usually liable to it.

On the broad scale of field cultivation I have notes of Clover-plants, "stem-sick" from this Eelworm, occurring on land where Tulip-root had been bad in Oats the previous year, and of Tulip-rooted Oats occurring on land where the Clover had been "sick" the previous year.

It is highly desirable, where there has been stem Eelworm-attack, to take as the next crop something which is not known to suffer from it.

Barley appears to be safe, and Wheat little attacked; and Flax, Peas, and Cabbage to be safe.

Turnips do not appear to have been noticed as infested, excepting in the single instance of my own experiment; and Mangolds appear to be safe from this attack, although sometimes suffering from another kind of Eelworm. Carrots and Parsnips are also, as far as we know, safe; and Carrots are especially mentioned by Dr. Kuhn as a good crop on land ploughed in to cure Eelworm infestation.

Cultivation of the land is another important point. If the land is worked by a plough with skim-coulter attached so as to pare off a thin surface-slice and bury it fairly quite down, and turn the clean earth on to the surface, in this way all the Eelworms (whether in the plants themselves, or those which will in all likelihood have left them and be lying quite in the surface soil) will be safely turned down out of the way, and (unless they are ploughed again to the surface) will be put out of the way of giving further trouble. In like manner, *trenching*

* The attacked Potatoes are stated to be distinguishable by the entire surface, but more especially the sides, being scattered more or less thickly with little tubercle-like swellings, each surrounded by a slight depression, and beneath these the tissue of the Potato is described as being brown, and apparently dry to the depth of about the twelfth of an inch. In this brown, disorganized tissue, which appears, from the description, much to resemble the brown, powdery material in which we find some of the Eelworms in Tulip-rooted Oat-plants, the Potato Eelworms were found in great numbers. The above is taken from Report by Prof. F. S. Scribner in Bulletin (of the present year, 1889) of the Tennessee Agricultural Experimental Station.

with the spade would be a very good remedy, for thus the clean uninfested earth would be brought to the surface; but mere digging, or even "double digging," in both of which the soil is only broken up for as far down as the work may go, cannot be expected to get rid of the attack. It is plain that wherever a piece of infested plant, or of infested earth, remains, that from it these Eelworms, which are gifted with most extraordinary life-powers, will start operations again.

Where land is known to be infested, and for any reason proper cultivation of the surface cannot be applied, a scourging dressing of gas-lime in caustic state would probably be a desirable application. As the Eelworms lie near the surface, this might be expected to kill them all, but of course proper care must be taken to leave the gas-lime exposed, and the land unworked and uncropped for some weeks, or the succeeding crop would almost certainly be poisoned. On this point I would give all necessary information, or forward the excellent leaflet, 'On Composition and uses of Gas-Lime,' by the late Dr. Aug. Volcker, Consulting Chemist of the Royal Agricultural Society of England, which leaflet is not as well known as it should be.

Transportation of the Eelworms in fodder, in manure, or in infested earth.—As it has been found that the *T. devastatrix* can survive the operations of digestion in animals fed on fodder infested by it, how best to manage the probably infested manure is a point for agricultural consideration. If it is carried back to the fields, it is quite likely that the Eelworms will go back in it and start attack on Oats or Clover, or whatever may suit them.

The most practicable plan* (though not perfect) would seem to be great care not to give dung from "stem-sick" Clover, or "Tulip-rooted" Oats to fields where either Clover or Oats were to be the next crop.

A vigorous, healthy, rapid growth is a great help towards checking the mischief, and rich manuring is advised for crops sown on land which has been previously deeply ploughed to get rid of Eelworm-attack; but also it is recommended by Dr. Kuhn that this should be not of stable-manure, which may very likely contain the pest, but rather of guano or superphosphate.

Infested earth may easily carry the Eelworms from one place to the other, and where garden-refuse is thrown to a common farm manure-heap, infested Onions, or Hyacinths, which are exceedingly subject to this attack, are very likely to cause mischief, and the little patches of

* In the above notes I have not entered on the powers of what is called latent life possessed by *Tylenchi*, that is, the power of remaining dried up for years and recovering when moistened, or again, the torpid condition which may be brought on by presence of various matters, or by decay, and recovered from by washing away the offensive matter. For these points, and many others relative to *Tylenchus devastatrix*, the reader is referred to the excellent work, 'L'Anguillule de la Tige,' by Dr. Ritzema Bos, previously quoted.

infestation in otherwise clean fields may thus be easily accounted for. The spread of attack from one of these may be prevented by digging a trench a foot or two deep round the infested area.

As a measure of direct remedy, the application of sulphates of various kinds has been found to be attended with great success.

In 1887, Mr. John Elder, of Uphall, Linlithgowshire, who has devoted careful attention to effect of treatment on Eelworm-attacked crops, applied as a dressing to "stem-sick" Clover a mixture of sulphate of ammonia, 4 parts; sulphate of potash, 1 part; steamed bones, 2 parts; this was given at the rate of $1\frac{1}{2}$ cwt. of the mixture per acre. This was followed up by a dressing of 2 cwt. per acre of sulphate of ammonia, and the result gave so luxuriant a growth that in little more than a fortnight after the second dressing the unhealthy plants (if any remained) had ceased to be noticeable.

In the treatment of the attack of stem-sick Clover at Rothamstead, of which the identification is given at p. 5, sulphate of ammonia and sulphate of potash applied together, and also sulphate of iron as a dressing without mixture, were found to be very useful.

The following is a copy of the report of the above experiments with which I was favoured, sent me from Harpenden on May 14th, 1889, by Mr. John J. Willis:—

"On April 3rd, two measured portions of the field were taken, each of which contained many affected plants of Clover, and the disease appeared to be spreading. To these the following manures were applied as a top-dressing in quantities per acre:—

"No. 1. Sulphate of iron, 2 cwt.

"No. 2. Sulphate of potash, 3 cwt.; sulphate of ammonia, 1 cwt.

"No. 3. On April 4th, to another portion of the same field was applied 1 cwt. sulphate of iron per acre.

"No. 4. On April 30th, over the whole of the worst-affected part of the field (*viz.*, the strip of land previously referred to, which had received the fish-manure in 1888) a dressing of 1 cwt. sulphate of iron, 1 cwt. sulphate of potash, and 1 cwt. sulphate of ammonia per acre were applied. This mixture was sown so as to overlap the diseased and the healthy portions.

"The plants which I now send were collected this day (May 14th) from the junction of the diseased and the healthy portions of the field.

"On experiment No. 1 and No. 2 the disease has entirely ceased, and the Clover is growing most vigorously; No. 2 seems the most effectual, and the Clover on this plot has made the most growth; not a blank is now to be seen. No. 3 has been less effectual than No. 1 in stopping the spread of *Tylenchus*.

"I send the plants from the edge of No. 4 for your opinion upon their condition.

“None of these manurial applications when sown as a top-dressing appear to be able to kill the *Sitona* maggots, the millepedes, or the small white worms, each of these insects being found this day in plenty.”—J. J. W.

From this it appears that sulphate of ammonia and sulphate of potash at the rate (together) of 4 cwt. per acre did best, for the disease entirely ceased, and the Clover made such a good growth that in the period between April 3rd and May 14th not a blank was to be seen. In the case of the sulphate of iron, it is of interest to notice that, though the application at 2 cwt. per acre caused the *Tylenchus*-attack to cease, the application of half that amount did not entirely check the spread of the disease.

With regard to the permanent effect of the above-named application to the Stem-sick Clover, I wrote to Mr. J. Willis, requesting his opinion on the subject, and was favoured by him with the following highly satisfactory reply:—

“Harpenden, Oct. 25th, 1889. The manurial applications tried in the *Tylenchus*-infested Clover-field at Rothamstead appear to extend their beneficial effects to the second crop as well as the first. The vigour of plant is now (July 26th) very marked on the portion which received 3 cwt. sulphate of potash and 1 cwt. sulphate of ammonia per acre; the growth of plant being less luxuriant with the 2 cwt. sulphate of iron. On each of these portions of the field, however, the ravages of the *Tylenchus* have quite ceased. On the portion which received 1 cwt. sulphate of iron only, some plants are even in the second crop dying off; so that the experiment clearly proves that a large amount of fertilizing material is required to enable the Clover-plants to withstand or to overcome the baneful effects of the *Tylenchus*.”—J. J. W.

Looking at amounts used in Mr. Elder's experiments, and the almost parallel one of Mr. Willis, it will be seen that Mr. Elder applied altogether $3\frac{1}{2}$ cwt. of mixture, consisting of 3 cwt. (all but 14 lbs.) of sulphate of ammonia—the rest sulphate of potash and steamed bones; whilst in the experiment No. 2 of Mr. Willis at Rothamstead, the application was at 4 cwt. per acre, of which 3 cwt. were sulphate of potash, and the remainder was sulphate of ammonia. But in both these instances, whether the ammonia or potash was the chief ingredient, good results followed immediately on application.

It may bear on the subject of applications at once useful to Clover and hurtful to the Eelworms to observe that in the record of the Woburn experiments before quoted it is noted that “Sulphate of potash has given the greatest yield; the addition to it of bone-dust and superphosphate with nitrogenous manures has given no appreciable advantage”; also in a table given by Dr. Ritzema Bos of effect of various chemical applications on *Tylenchi*, that of ammonia and also of

ether are the most rapid of all. "L'ammoniaque dilue de 100 parties d'eau tue les larves comme les adultes presque instantanément."

SUMMARY.—To give the results of the above observations shortly. We find a disease in Clover, which is more or less characterized by a peculiar growth, to be caused by the presence of the "Stem Eelworm," the *T. devastatrix*.

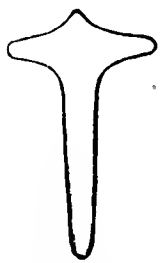
This attack can be transmitted from one kind of plant, or from infested earth, to another subject to it, and of these the crops chiefly to be considered here are Oats and Clover. For this reason the above crops should not succeed each other where there has been infestation.

One *measure of prevention* is deep-ploughing, or in smaller areas trenching, such as will turn a fresh, clean, uninfested surface to the top; and as a *remedy*, when attack is even seriously present, a dressing chiefly or entirely composed of sulphate of potash and sulphate of ammonia at the rate of from $3\frac{1}{2}$ to 4 cwt. the acre has been found to answer.

Gnat Midge; "Red Maggot." *Cecidomyia*, ? sp.

Accompanying the diseased Clover-plants, which were sent me early in the year, I found in all (or in almost all) cases that there were small orange or reddish maggots about the roots. These were of much the same size, shape, and colour as the well-known "red maggots" of our Wheat and Barley, and, like these, are the maggots of a small Gnat Midge, scientifically of a *Cecidomyia*.

On January 29th Mr. Francis E. Fraser forwarded me specimens of diseased Clover from Woburn, and from one plant, which was quite dead above ground, and decayed, I took from the decayed bark, or immediate outside of the stem, nine "red maggots" of different sizes up to about one line long, of various tints from orange of various shades



Anchor process, much magnified.

to almost white. These larvæ or maggots were legless, cylindrical, narrow, blunt at the tail, and pointed towards the small head, which was furnished with a small pair of horns. Beneath, near the head, they were furnished with a dark brown powerful "anchor process," or "scraper," of the general form figured in outline and magnified; that is to say, markedly projecting in the middle, *not* notched (as is often the case with the anchor process), and the shape of which may prove of use presently in identifying the species.

On April 3rd, Prof. Herbert Little forwarded me from Coldham Hall, near Wisbech, similar specimens of maggots which were believed to be doing mischief at the Clover-roots. He also mentioned them to me as being exceedingly prevalent in various places. I also had specimens sent from Rothamstead which occurred at the root of

the stem-sick Clover; and on May 18th Clover was sent me from Chelsing, near Ware (also obviously suffering from stem-sickness), and which also had accompanying many of these orange or red *Cecidomyia* maggots.

In this case some of the maggots were only about a third grown, and though some were loose in the earth, I found some buried in the decayed matter of the stem. I also found several together in the hollow of a dead and decayed stem, and, joining these circumstances to that of the contents of the maggots being brown, there appeared some reason to think that they were then feeding on the decayed matter.

I could not find any evidence that they were feeding on the living tissues, and in the case of the Rothamstead experiment—as these “red maggots,” and other plant-pests, and also some small white worms still remained in the earth round the Clover after it had been thrown by dressings into a healthy, vigorous growth, there did not appear to be cause to think that they were then doing mischief.

Still we need to know their whole history, especially where and on what this species feeds in summer. There is an American Clover-seed Midge, the *Cecidomyia leguminicola*, Lintner, of which the maggots feed in the heads of Clover, and go down into the earth to complete their changes; and a portion of the late brood also (as recorded by their observer, Dr. Lintner) spend the winter in the earth at the roots of the Clover. At first it appeared likely that this species was the one under observation, for the larvæ or maggots sent me minutely resembled those of this Clover-seed Midge, and the perfect Gnat-fly or Midge, of which I reared a specimen,—on careful and skilled examination independently of my own,—appeared to be certainly of this species, *Cecidomyia leguminicola*, Lint. I could not, however, obtain any notes of the maggot having been observed in Clover-heads in the summer; and on microscopic investigation, by comparison with specimens of the maggots of this Clover-seed Midge sent over to me by Dr. Lintner, I found that the anchor-process, &c. (see fig., p. 12) did not usually correspond in ours with that of the Seed-maggot. In ours the middle projected; in the Seed-maggot it was deeply notched, still there was a single specimen of which it was at least open to doubt whether it did not correspond exactly in form with that of the extremity of the process of the Seed-maggot. Therefore I think this kind may be slightly present, and watch should be kept whether the seed-heads of Clover are infested.

There is another attack (that of the Clover-leaf Midge, the *C. Trifolii*), of which the maggot infests the lower leaves of Clover, fastening them together, so that the bent edges fit together and cause them to resemble little pods, and on opening these the galls caused by

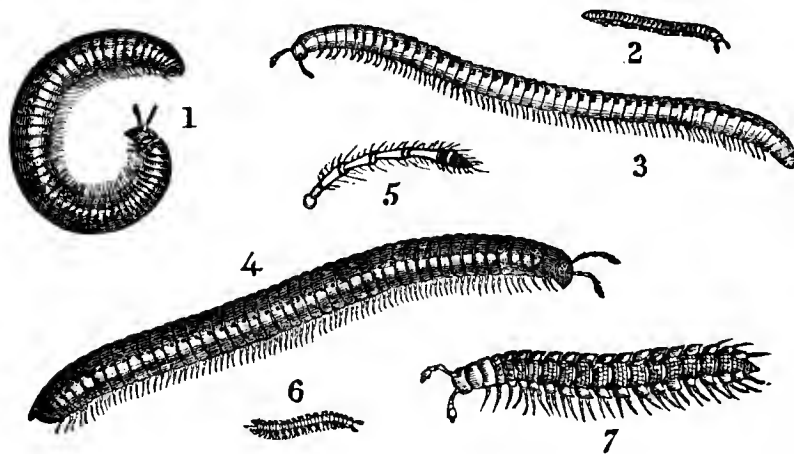
the larvæ (or little cocoons spun by the larvæ within) may be found, and in these folds the change to pupæ, and the perfect fly takes place.

The maggots of the Clover-leaf Midge are somewhat smaller than those of the other, the specially American kind (the *C. leguminicola*); also are more thickly marked with punctures. The little two-winged Clover-leaf Midges are also rather smaller than the other species, and may be generally described as of various shades of brown; the abdomen reddish-brown, ringed with black; two wings showing prismatic colours, yellow at the base, and beset with brown hairs.*

The Midges of these two kinds are almost precisely similar, excepting that the Leaf Midge, like its larva, is the smallest of the two kinds, and the antennæ of the female have fewer joints, namely, 14 (or, according to Löw, 14 to 15), instead of 16, as in the Seed Midge.

As for some years back the orange *Cecidomyia* maggots have been found at the roots of our Clover, it would be very desirable to investigate this matter further in summer.

Millepedes; "False Wireworms"; "Thousand legs." *Julus guttatus*, and other species of *Julidæ*.



JULIDÆ; POLYDESMUS.

1, *Julus Londinensis*; 3, *J. guttatus* (*pulchellus*, Leach); 4, *J. terrestris*; 5, horn; 7, *Polydesmus complanatus*; all magnified; and 2, *J. guttatus*; 6, *P. complanatus*, nat. size.

The Millepedes, *Julus* Worms, or False Wireworms, have been so fully noticed before in these Reports, that I now only refer to them because enquiry was made relatively to what they might be doing in earth at Clover-roots.

These Millepedes might be doing good, or harm, or both together, for they are considered to be quite general feeders; that is, they live on animal or vegetable matter, alive or dead. They are recorded as

* For full details of *C. Trifolii* in all stages, see D. Löw's descriptions, 'Verhandl. Zool. Bot. Gesell. Wien,' p. 143, 1874. For *C. leguminicola*, see paper by Dr. J. A. Lintner in 'Tenth Report of Entomological Society of Ontario,' with further observations in 'Twelfth Report,' by Prof. W. Saunders, with figures.

preying on slugs, snails, and worms, and also on insects in their various stages. Likewise they feed on fruit, and especially on Strawberries; on roots, such as Potatoes, Mangolds, &c.; and of Mangolds the Spotted Millepedes are so ravenously fond that slices may be very serviceably used as traps in garden cultivation. I have myself seen them swarming over the cut surface in quantities which would very materially lessen the damage to the more valuable ground fruit crops. They have been noticed doing harm at the roots of Wheat in spring, and also as sweeping off young Mangolds as the seed germinated.

With regard to their life-history—the females are stated to lay their eggs from about the end of December until the following May, that is, until about the middle of the spring. The young resemble the parents throughout their lives, excepting that at first they have either no legs or only three pairs; these increase in numbers (up to whatever may be the full number of pairs) at successive moults. They are two years before attaining maturity and power of reproduction.

They are stated to propagate most freely in undisturbed land; and where this is bare, or, on the other hand, there is a permanent crop, a frequent stirring of the surface-soil during the latter half of winter would be likely to do good in one case; or in either of the above cases ploughing with a skim-coulter so as to turn the top slice well down and leave it there would bury down much infestation.

But where the Millepedes are in a growing crop, there seems no way of destroying them in field cultivation. Salt and nitrate of soda will kill them if applied so as to touch them in solution, but this would be likely to kill the crop; and if the above substances are merely applied dry, and allowed to melt gradually into the land, even at the rate of a tablespoonful to a pound of infested earth, they appear to do no good.

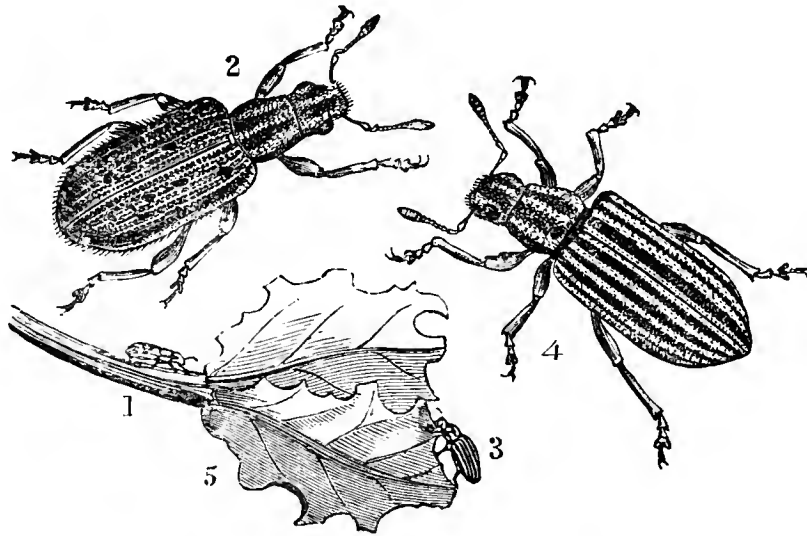
If desirable to dislodge them in Clover, it would appear very possible that gas-lime (of course applied with due care), which sometimes brings on a beautiful growth of Clover, might be of use. But in the instances in which the Millepedes were brought before me last season, it was very likely that they were simply living on minute worms, or decayed matter, which was plentifully present. On another occasion it would perhaps be possible by careful microscopic examination to make out, at least to some degree, the nature of the food which they were consuming.

Clover and Pea Weevils. *Sitona lineata*, Linn. (and other species).

Maggots of the *Sitonas*, or Clover Weevils, also occurred in earth round Clover-roots, and through the kindness of the Rev. Theodore Wood, F.E.S., of Baldock, Herts, I am favoured with an observation

regarding time of feeding of the *Sitona* Beetles, which may be of practical service relatively to means of prevention.

These small Weevils are of the shape figured much magnified below, and, when freshly developed, striped or variously marked with white, greyish, or dusky minute scales; but as these are easily rubbed off, the dark specimens are often almost similar in appearance, from the absence of characteristic marks on the black ground. They do (as has long been known) immense mischief to the leafage of young Peas and Beans, as well as to Clover, by feeding on the leaves, scooping the edges gradually away in more or less semicircular patches, as shown above in the figure of an injured Pea-leaf. So far as I am aware, it has generally been supposed that this mischief was done by day.



SITONA CRINITA AND *S. LINEATA*.

1 and 2, *S. crinita*; 3 and 4, *S. lineata*, nat. size and mag.; 5, leaf notched by *Sitona* Weevils.

John Curtis states in his 'Farm Insects,' p. 343, regarding attack of these Weevils noticed near Hertford at the end of March, 1844, that:— "At this period of the year they issued from the ground, from nine to ten o'clock in the morning, to feed all day upon the peas; and they retired under the clods of earth on the approach of evening." At pp. 344 and 345 of the same work, a long observation of the method of attack of these Beetles is quoted by John Curtis, in which the difficulty of obtaining a sight of their method of feeding (on account of their extreme shyness under observation) is specially noticed, but that after long waiting they were then "observed to feed by taking the edge of the leaf and holding it steadily between their legs" whilst they devoured it as described. From these and other observations it does not appear to be open to doubt that a portion of their feeding is done by daylight, but that they are to some extent night-feeders also appears from the following note with which I was favoured on September 30th by the Rev. Theodore Wood:—

"It is commonly stated that the *Sitones* Weevils feed only by day, concealing themselves under clods of earth, &c., during the hours

of darkness. My own experience is exactly opposite to this. I have found the Beetles in thousands upon their food-plants by day, but seldom or never engaged in feeding. Whereas I do not think that I have ever gone out with a lantern by night, and examined a row of growing Peas or Beans, without finding the Beetles upon the leaves in hundreds, all busily nibbling away at the edges. At such times they are not nearly so susceptible to alarm, and do not fall at the vibration of a passing footstep. I find that they feed most freely upon damp, mild evenings, especially in the months of April and May. And I also find that a thick layer of soot is as efficacious as anything for keeping them away. Only, this must always be renewed after a shower of rain. My own observations were made in a garden in which it was quite impossible to grow early Peas without something like nightly supervision; and, without exaggeration, I may say that I have sometimes seen an average of a dozen Weevils upon every leaf during my rounds at about 10 p.m."

The above very practical observations may prove of great service, for the fact noticed of the Beetles not falling off the plants as in the daytime at once puts them much more under the influence of soot or other dressings that may be used, and this plan might act so well in garden cultivation where the Weevils are most destructive to young Peas that any notes regarding its trial would be very acceptable.

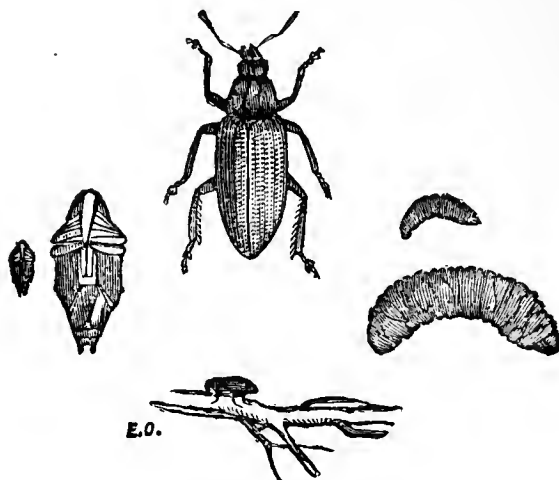
Up to the year 1882 nothing was known as to the early history of these Clover (and also Pea and Bean) Weevils, but on April 6th in that year some grubs about a quarter of an inch long (when full-grown), wrinkled and legless, of a whitish colour, with ochre-coloured head and dark brown jaws, were observed by Mr. Reginald Christy, of Boynton Hall, near Chelmsford, to be doing injury at the roots of the Clover.

The maggots were mostly found "at or near the tap root of the Clover, and some at the extremity of the smaller roots, which showed injury from their gnawings; in some cases large holes had been eaten, and in all cases the part thus eaten had turned black."*

Some of the Weevil-grubs sent me soon ceased feeding, and had formed hollow chambers in the earth by about May 8th; at the end of May some of the maggots were turning to the chrysalis state, and the Weevils (*Sitonas*) from these began to appear about June 20th. In the same year specimens of Weevil-maggots were also sent me, taken from Pea-roots by Mr. T. H. Hart, of Kingsnorth Farm, Ashford, Kent, from which I reared the common Pea (and Clover) Weevils, *Sitona lineata*. The following figure, drawn by myself at the time, conveys (though not so artistically as could be wished) the Weevil in its three

* 'Report of Observations of Injurious Insects during the year 1882,' pp. 13, 14. By E. A. Ormerod.

conditions, and gives a very accurate idea of the elongated appearance of the grub.



SITONA LINEATA.

Pea and Clover Weevil, grub, and chrysalis; all nat. size and magnified.

In this case some of the Weevil-grubs were found lying along the main root, which bore marks of channels having been eaten along it, but, for the most part, the soft gall-like growths appeared preferred as food. As the early stages of the *Sitona* Weevils had not been recorded, as far as I am aware, up to the date named, I then in my Report for 1882 entered on the subject in detail, and now only repeat some portion, as it is of interest to be able to compare the different methods of attack to Clover-root, which I have received specimens of during the last season, in consecutive pages.

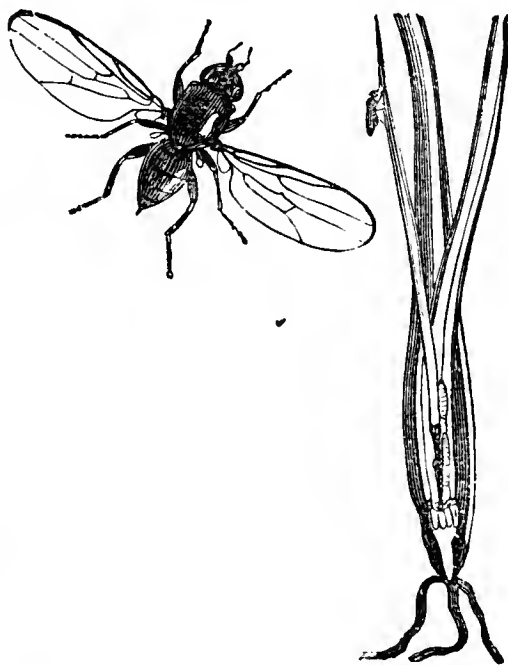
CORN.

Frit-fly. *Oscinis frit*, L. (? *Oscinis vastator*, Curtis).

The only notice which has been sent me during the past season of the decided presence of Frit-fly attack (which, it will be remembered, caused much harm to young Oat-plants in Cornwall and Devon, and at a few other localities, in the early part of the summer of 1888) was sent me by Prof. Wm. M'Cracken, of the Royal Agricultural College, Cirencester; but whilst this paper was being written, I have received specimens of young infested winter Oat-plants, which may prove of much use in giving a clue to the winter habitat of this attack.

The Frit-fly is a small, black, shining, two-winged fly, and the mischief that it gives rise to notably in this country, is by reason of its small, whitish, legless maggots feeding in the heart of young Oat-plants, and so destroying the central shoot. With us it noticeably avoided Barley, but in continental returns it is recorded as infesting Barley as well as Oats, and in summer as being found in Meadow-grasses, and as infesting the *ears* of Barley and of Oats also.

The following observations of Prof. M'Cracken are well worth study relatively to date of sowing influencing amount of attack on the plant. The same coincidence of worst attack on the latest-sown Oats, and absence or slight presence of attack on the winter or early spring-sown Oats, has now been observed in two seasons, and the same coincidences have also been observed by Prof. M'Cracken in the case of the Gout-fly, or *Chlorops tæniopa* attack on Barley. This may reasonably be supposed to be because the plant got a good start, and if we could gain more observations on this point, particularly with some notes of weather accompanying, it might be a great help.



OSCINIS VASTATOR.

Frit-fly, nat. size and magnified; and infested plant with maggot inside.*

In 1888, Prof. M'Cracken wrote me that a very large area in the district round Cirencester had suffered greatly from the Frit-fly attack; the crop from which the specimens then enclosed were taken was practically destroyed, excepting for Hay; but he added, "*Winter Oats and all early spring-sown fields seem to have escaped.*"

In this past season (1889), Prof. M'Cracken, writing from the Royal Agricultural College on August 1st, observed as follows:—

"The Frit-fly has again been the most plentiful of injurious insects, and, as was the case last year, the degree of injury corresponds to the date of sowing. For example, in one field Black Tartarian Oats (the sort most largely grown here) were sown on March 29th, and enjoyed almost complete immunity from attack; in another field sown on April 29th, over seventy per cent. of the first stems were destroyed. The plants which had their first shoots killed in this way immediately commenced to tiller, so that the land continued to have a fairly close

* Curtis' figure of *Oscinis frit* is given to illustrate the paper, as even if there are minute differences between the *O. frit* and *O. vastator*, the above figure conveys an excellent idea of the Frit-fly which troubles us here.

cover; but the secondary stems were always puny and unprolific, compared with the original ones.

“Early sowing, where possible, appears to me to be an obvious preventive, and a dressing of 1 cwt. or so of nitrate of soda, to stimulate the crop to pass quickly through that stage of its growth when it is liable to attack, is one of the best measures available.”—W. M'C.

This suggestion of an early application of fertilizing dressing, or, indeed, whatever treatment is calculated to push on as early and healthily rapid a growth as can be managed, is well worth looking at in the light of what happens commonly to young Corn-crops when maggot-attacked in the bulb. When rain comes (unless the plants are quite past hope), the side-shoots make a start, or, if stimulating dressings are applied *when* the crop is failing, the same result happens, and something towards a yield is secured. But the side growth is late, and the crop probably ripens unevenly, with a varying sample.

With regard to Frit-fly, this is such an unusual attack in this country that it may be hoped there was some special cause for its specially injurious appearance, but the principle of, so to say, getting beforehand with attack may prove of much use in other cases of Corn-infestation of bulb or stem.

Winter form of Frit-fly attack.—On November 12th I received from Mr. George F. Gay, Wylie, Bath, some young Oat-plants, with a memorandum:—“I herewith send you some plants of Winter Oats, which are being killed by an insect (a small maggot), which you will doubtless find in some of the stems, as I have done.”

The plants sent me were from about two to three inches high, and the upper part very much reddened; on drawing this gently the shoot came away, and within, at the injured part, I found a small white maggot of some kind of two-winged fly. These maggots were from about 1-16th to 3-16ths of an inch in length, legless, cylindrical, and with well-marked segments. At the head end they were furnished with strong-curved mouth-hooks, and at the tail extremity the two tracheæ ended in two well-developed wart-like tubercles. Near the head extremity the tracheæ ended on each side in a very distinguishable branched spiracle.

This appearance agrees with descriptions of the larva of the Frit-fly, also with what I have myself seen previously of these larvæ in the summer Oat-plants; and also when I examined these larvæ (or maggots) now sent, together with specimens of the summer brood, under a one-inch object-glass, I could distinguish no difference; therefore I think we have now learnt, with regard to one of our young Corn-stem or Corn-bulb maggot pests, what has been so long needed regarding most of them in this country; that is, where they *spend the winter*. We still need to know where the summer brood from the June-

or July-hatched flies lives, but this completes the winter's life-history, and shows us where then to find the enemy. The maggots that feed in the young winter Corn-plant are from eggs laid by the summer brood of flies, and these winter maggots will feed and turn to chrysalids, which will in the early part of next season develop their flies to start attack on the spring Corn, and so the year's circle is kept up. Where there is nothing suitable for the flies (Frit-flies or others) to lay their eggs on, they will die without doing harm. In the case sent me the attack was apparently so bad that part at least of the crop was past hope; but, where this is not the case, some stimulating dressing to push on the uninjured plants would be desirable. These, of course, would be according to the judgment of the owner, but in the case of Oats, dressings of sulphate of potash, or sulphate of potash and of ammonia, &c. (see references in Index), would be worth consideration.

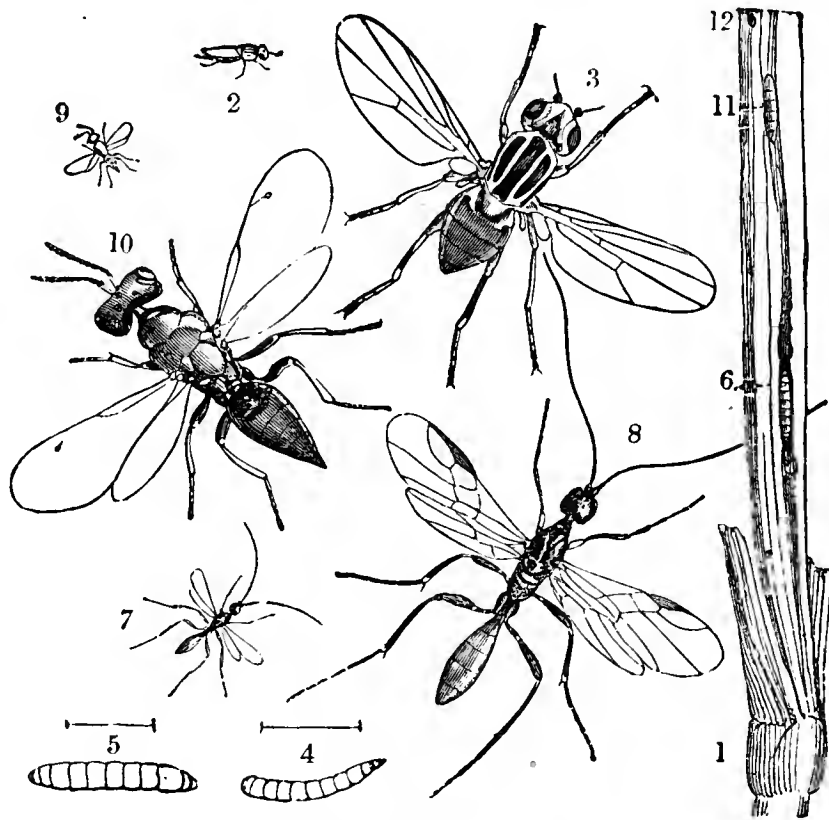
Where the crop cannot be saved, it is highly important so to treat the surface of the land that the maggots or chrysalids may be destroyed, which (if nothing is done, or the surface only lightly stirred or cultivated for another crop) will almost certainly produce a new brood in spring. For this purpose, ploughing with a skim-coulter attached, so as to bury the infested surface well down, would be about the best treatment.

In the case of the Oats the bright reddish appearance of the injured plants would draw attention to them at once, and probably in other cases there is discoloration accompanying maggot presence which would show that something is wrong in the heart of the plant. More information on this point would help us to improved preventive measures; and we also need to know whether with us, as on the Continent, the summer brood is to be found in the ears (instead of as in the case of autumn and spring attack) in the bulb of the young corn plant.

Gout Fly; Ribbon-footed Corn Fly. *Chlorops tæniopus*, Curtis.

The Barley-attack known as Gout occurs more or less every year; in 1887 it did serious mischief, in 1888 it was very little reported, but in the past season of 1889 enquiries were sent me regarding it at intervals from July 6th to Sept. 24th, and the specimens of infested plants were in most cases far more stunted in growth than has been the case in previous years. This attack, as is well known, is caused by the small black or yellow fly figured on p. 22. Whilst the plant is still young, and the forming ear is wrapped in the sheathing leaves, the Fly places her eggs either within these leaves, or so that the maggot can make its way through them to the lower part of the ear; there it feeds, and afterwards eats its way down one side of the stem to the uppermost knot, and beneath the leaves the maggot changes to

a reddish chrysalis, from which the Fly appears about harvest-time, or a little after. In common infestation the shortened upper joint of the straw with the blackened channel down one side (as figured), and the ear often partly or entirely still wrapped in the leaves, are the characteristics of the attack; but in the past season the whole plant was often so exceedingly stunted that the ear itself in some cases was hardly observable.



CHLOROPS TÆNIOPUS.

2—6, Maggot, chrysalis, and fly of *Chlorops tæniopus*, nat. size and magnified. 7 and 8, *Cælinius niger*; 9 and 10, *Pteromalus micans* (parasite-flies), nat. size and magnified; 1 and 12, furrowed and infested Corn-stem.

The first specimens were sent me on July 6th, from Stebbing Vicarage, near Chelmsford, by the Rev. A. R. Bingham Wright; these plants were only about $4\frac{1}{2}$ to 6 ins. high, and the forming ear quite enfolded in the sheathing leaves, so as (in some instances) to give the plant the shape of a long, narrow Maize, or Indian Corn, cob on a short stem. The larva was present, but was not full grown, and the damage was characteristic in one or two cases, as far as the gnawing of one side of the ear was concerned, but not in all, from the plant or ear being still so little developed.

On July 8th, infested Barley-stems were forwarded to me by Mr. T. H. Thursfield, from Barrow, Broseley, in very similar condition to the above. There were very young plants in which the ear was hardly developed, or destroyed, so that there was only one ear in which the furrow characteristic of Gout Fly attack was noticeable; the stem below was quite short and stunted. The Fly was in early pupal state.

At the same date, specimens very similarly affected were sent me from Akenham, near Ipswich, by Mr. J. A. Smith, with the

observation:—"I enclose herewith specimens of Barley affected with gout. I have often noticed this in Oats, but is it not rather new in Barley?" In this instance also the ear was very young, and gnawed down part of one side, but the stem (or rather what would have been the stem presently) was not attacked, apparently from not being enough grown to afford material for the purpose. In this instance chrysalids were present on July 9th.

Specimens of Barley attacked by *C. taniopus* were brought from New House Farm, St. Alban's, by Mr. Dickenson, jun. These were much injured, but the plant was about half to three-fourths of the full growth; and the ear, though still quite folded in the sheathing leaves, moderately developed, and the furrow of the maggot still green, traceable to the first knot, just above which, in one instance, I found the maggot living.

On July 12th, Mr. J. Eardley Mason, of the Sycamores, Alford (Lincs.), forwarded me specimens of *Chlorops*-attacked Barley from a field in the neighbourhood, with the information that the pest was doing appreciable but not serious harm.

Prof. Allen Harker, writing from the Royal Agricultural College somewhat later on, that is, July 29th, remarked:—"But what we have suffered most from has been Gout Fly. Various reports given me stated 50 per cent. as amount of attack, but on specially instructing two good students to make a statistical survey in various parts of the field, I got as probably an accurate return 20 to 25 per cent. of this attack."

The following account of amount of appearance of infestation in coincidence with date of sowing, which was sent also from the Royal Agricultural College,



Plant of Barley diseased by Gout Fly attack.

Cirencester, by Prof. W. M'Cracken, is well worth study for practical purposes:—" . . . Another field gives a further example of the influence of the date of sowing upon insect-attack." In this case the crop was Barley, and the depredator the Gout Fly.

"The field was sown in three patches as the preceding crop of Swedes was fed off. The first patch was sown in March, and is practically free from injury. The second part was sown on April 6th, and is affected to the extent of about 2 per cent. The third part was sown on May 3rd, and has suffered to the extent of not less than 20 per cent. Having been thickly sown, however, the yield will still be fairly good."

The above note joined to that of Prof. W. M'Cracken, of similar observation as to amount of Frit-fly attack on Oats sown at various dates, deserves careful thought. They point to the early-sown Oats being so well established before the Gout Fly was ready to attack them, that, when it did come, either the plant had passed the condition in which it is suitable for egg-laying, or it was so strong that it grew on without injury from the attack.

On July 31st, *Chlorops*-attacked Barley-heads were sent me by Mr. D. Petrie from Dunmore, Durrow, Queen's Co., Ireland, as samples of an injury which had been noticed for the first time last year, and was doing much more harm on this year's crop.

Of the later reports, one sent from near Farnborough, Kent, on August 15th, noted that, of two fields that were infested, one was damaged in some parts to the extent of nearly half of the crop; in this instance some of the heads were still quite stunted and wrapped.

The following observation was sent on August 22nd from Fairfield, near Bridgewater, by Mr. H. L. T. Blake, accompanied by specimens of Barley, in the straw, badly diseased by *Chlorops*-attack. The plants had the heads still sheathed, and ran hardly 10 in. in height. Of these Mr. Blake noted:—"The plant commenced to fail (perceptibly) as it first came into ear, from which period of its growth it got gradually worse, until it dwindled down almost into nothing, and the ear, you will notice, has entirely perished. After the original ear came up and died away, other shoots have sprung up, as you will perceive; but they are of very feeble growth, and are quite green, while the rest of the Barley that has escaped the disease is almost ripe for cutting. The soil is of red marl, facing north, and the ground is undulating."

On August 27th, specimens that were poor in growth, but still in which the ears were visible, were sent me by Mr. J. B. Newitt, Cranford, Kettering, with the following note:—"Here is a very considerable amount of damage done to the crop, and the ears, where attacked, have in most instances not fully grown out of the sheath,

and look stunted; the grain looks coarse, and not at all like the rest of the kernels. The land is clean, and in good condition; and the crop, taking a bird's-eye view, looks all that can be desired, but on close examination I should think there are not less than one in every thirty ears affected."

On August 29th a sample of Chevalier Barley was forwarded to me from a sixty-acre field by Mr. J. Temple Johnson, Sutton Court, Sutton-at-Hone, Dartford, Kent, with a note that about a quarter of the crop was damaged as sample sent. This again was from *Chlorops*-injury; but in this case the plants were fairly grown, though showing all stages of disease upwards, from the ear being still enclosed to being free, with the characteristic black furrows.

The latest specimens sent me during the season were forwarded to me by Mr. W. B. Close (of 17, St. Helen's Place, London) on September 24th, as samples of an infestation which had been doing much harm in the Barley crops in the neighbourhood of Danehill, Sussex, and from which the farmer had suffered so severely that Mr. Close promised to endeavour to obtain some information about it.

SUMMARY.—From the above notes it will be seen that the attack, so far as reported, did not extend further north than the neighbourhood of Alford, Lincolnshire, but was scattered over the more southerly parts of England, in some cases doing considerable damage.

At Cirencester this was estimated (on the field specially examined) as at 20 to 25 per cent., and also (by another examiner) on a part sown on May 3rd as 20 per cent. Near Farnborough, Kent, one of the fields reported was damaged in some parts to the extent of nearly half the crop; and near Dartford (Kent) about a quarter of the crop was considered to be damaged on a sixty-acre field similarly to sample described above. In another case about one ear in thirty was considered to be infested, and in others the ear was so totally aborted that the plants would be totally useless, excepting for what small amount of fodder they might serve for.

The quite unusually large proportion of the plants which were stunted completely down to the shape

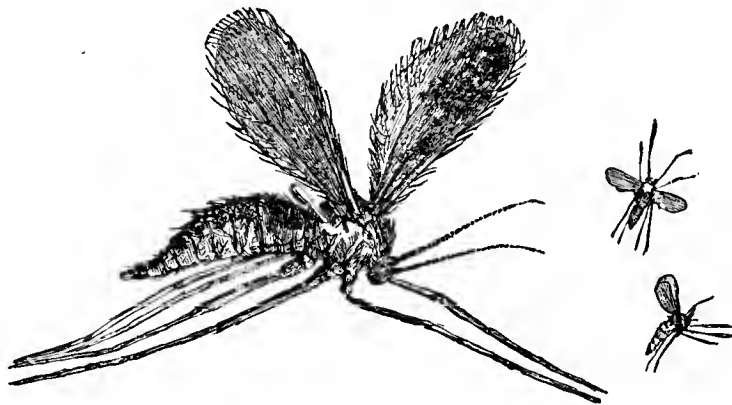


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Stem of Barley attacked by *Chlorops*, showing blackened maggot-channel.

figured at p. 23 was very remarkable, and to this I attribute that so many of my contributors enquired regarding the attack as being one not before observed in the district. In some cases it was only by laying the samples received side by side, and opening on from the smallest to those sufficiently developed to show the characteristics of *Chlorops*-infestation, that I was able to make out with certainty the cause of the evil. The notes from Prof. M'Cracken on early sowing are a help onwards to prevention, and as we know that in Germany the maggot of the winter brood passes the season in the heart of the young Corn, we may hope, as the Frit-fly Maggot has now been found in its winter habitat, that the *Chlorops* Maggot, which is excessively like it, may also be observed, and give us the long-needed clue to better prevention of this long-standing trouble.

The Hessian Fly. *Cecidomyia destructor*, Say.



CECIDOMYIA DESTRUCTOR.
Hessian Fly, nat. size and magnified.

During the past season, as well as in the previous one, very little damage has been reported from Hessian Fly attack, but at the same time it will be observed, by glancing over the following notes, that in almost every instance in which information was sent me of it being observed at all, it was very prevalent.

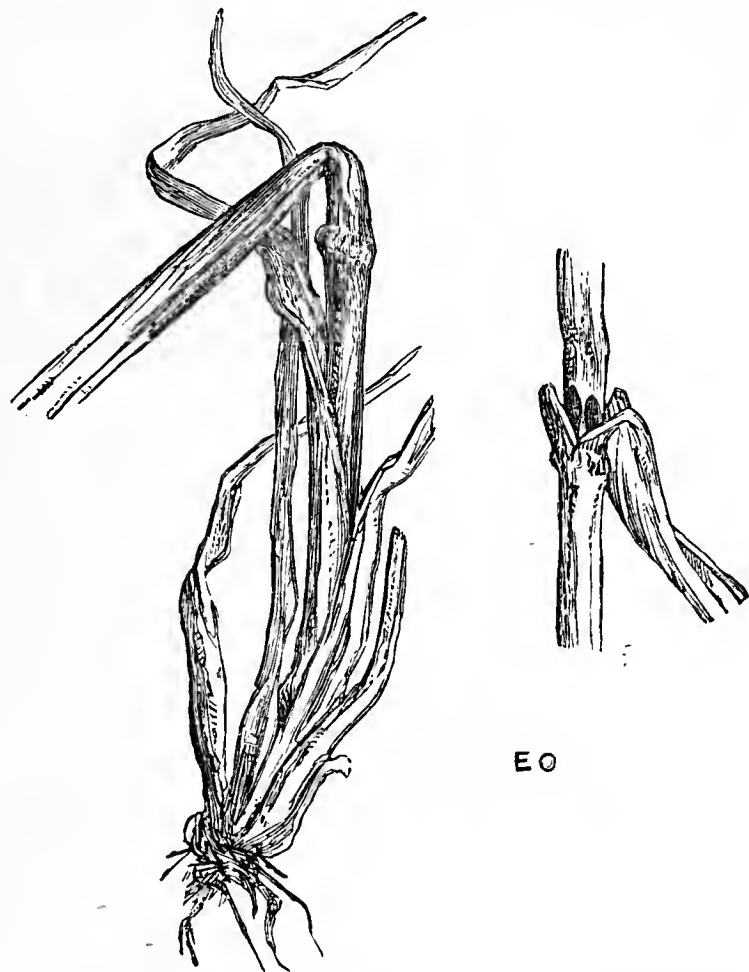
It will be seen that in one report of the condition of fifty-nine acres of Barley, that about every fifth straw was considered to be broken down by this attack at about the second joint above the root, but amongst the various specimens sent to me, I did not in any case find many flax-seeds on a straw, and sometimes only one or two on each straw in the whole of the sample sent me by one sender.

The localities of attack reported to myself were, as before, in the more easterly part of England, excepting a note of presence at Hastings, and the widespread appearance on the grounds of the Royal Agricultural College, Cirencester, and the surrounding neighbourhood.

On July 7th, Mr. J. Eardley Mason, writing from Alford, Lincolnshire, remarked:—"Although the Hessian Fly is so widespread, I do

not think that serious harm has been done. It is worthy of note, however, that the effect on the Wheat in producing stunted ears is more marked than in last year."

Mr. James Walker, writing on July 24th from Ashwell, Baldock, Herts, forwarded me specimens of Hessian Fly-infested Barley-stems, with the mention that :—"We have about fifty acres of Barley that



Attacked Barley-stems. 1, elbowed down; 2, showing "flax-seeds."

has about every fifth stem broken down with it at the second joint from the root, and I can find it more or less in most of the Barleys that I have examined, also a few in the Wheat."

On July 30th, Mr. J. Walker, reporting further, remarked :—"I am very sorry that we have such a severe attack of the Hessian Fly, but it does not seem to do much damage on any of the other crops, except the one fifty-acre field of Barley where I first discovered it, and it will destroy several bushels per acre on it."

On July 30th, specimens of Wheat-straw infested by Hessian Fly were forwarded me by Mr. K. Rix from Somerleyton, near Lowestoft. In this case I did not find more than one chrysalis present on each straw, and Mr. Rix mentioned that although he found "Fly" present in several pieces of Wheat, yet it was not in great number.

Very similar specimens, that is to say, Wheat-straw with very little infestation, not more than one or two specimens on each stem, were sent me on August 8th from Salisbury Hall, Ridge Hill, Barnet, by Mr. R. Makins, and in this case also it was reported as not having done much injury to the Wheat.

Mr. Edward Blundell, of Birchmoor, Woburn, also noted, with regard to presence of Hessian Fly :—“ I am sorry to say the Hessian Fly seems to me more abundant than in previous years. I have not been into a Wheat or Barley field where I have not easily found the puparia—on my own farm here, in different varieties of wheat ; at a farm I am carrying on near Bedford ; at Hastings, where I was staying last week ; and at Cirencester, when I visited the College as Examiner in Practical Agriculture.”

The Hessian Fly-attack at Cirencester was the most important that was reported, but even in this case, as will be seen by the two following observations, although the attack was very prevalent, the loss was not, in the very worst cases, noted to an extent that could be called severe.

On July 29th, Prof. Allen Harker wrote me from the Royal Agricultural College as follows :—“ Just a line to tell you that Hessian Fly is pretty bad with us, both in the fields around and in our own experimental Barley plots. The students are bringing in hundreds of them every day, not only in the flax-seed state, but in the earlier condition, while the outer coat is still white—though hitherto all I have got examined have the larva distinctly separate, and withdrawn from the skin which is to become the puparium.”

A few days later, that is, on August 1st, I was favoured with a few lines more of information regarding this attack by Mr. W. M'Cracken, Professor of Agriculture at the Royal Agricultural College :—“ The only other pest which appears to have done really serious damage is the Hessian Fly. I have examined many fields of Wheat and Barley in this neighbourhood, and I have in no instance failed to obtain specimens, but I do not think that the injury exceeds 4 per cent. in any case” ; he also noticed attack near Nantwich, Cheshire.

The following note, sent me on July 28th from Boynton Hall, Roxwell, near Chelmsford, by Mr. Reginald Christy, gives the same observations as most of the other notes—of considerable prevalence of the attack, but of little damage in consequence :—“ I enclose a few stalks of Wheat, attacked, as I suppose, by *C. destructor*. There seems to be a good deal of it about here : almost every field I have examined has a few stalks round the headlands attacked. I may say I have not been far about to look for them, but my own fields all contain the insect, and I have found it very abundant eight miles from here. They do not seem to have done a large amount of damage, as the Wheat has recovered itself where strong : but I should imagine on a poor, hungry soil they would do a great deal more. I have not had time to examine the Barleys, but will do so, if possible, soon.”

As it appeared of considerable interest to know what the amount of attack might prove to be when the season's observations were complete at Revell's Hall, near Hertford, where the attack was first recorded on

its appearance in England in 1886, I wrote to Mr. George E. Palmer, and was favoured by him with the following note:—"In reply to yours of yesterday, I have observed very little Hessian Fly this year in the Corn before harvest, and to all appearance little harm has been done to the crops by it; but that it is still present in large quantities is proved by the number of puparia we find in screenings from the threshing-machine. The Corn being very much laid by the heavy storms this summer, made it very difficult to find the injured stems while the corn was standing, and it is in fine, hot summers, such as 1887, when the injury is most observable. I think this may account for the *non-appearance* in districts where it had previously been observed; still I do not think we shall find it a very serious foe, and I think much more damage is done by Slugs, Wireworms, and *Sparrows* than has been, or ever will be done by the 'Hessian Fly.'"

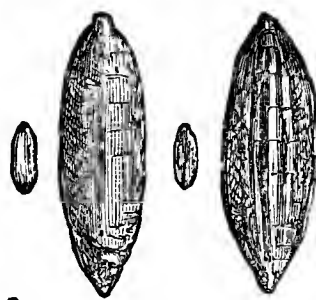
The report of the season from Mr. D. Taylor, from Daleally Farm, Errol, N.B.,—the locality of the first observation of Hessian Fly in Scotland,—was:—"I have not seen it at all"; and Mr. John Elder, writing on Nov. 19th from The Holmes, Uphall, Linlithgowshire, N.B., reported:—"Barley showed no sign of Hessian Fly." It is of considerable interest to note that as yet (as far as I am aware) it has not been found in Ireland.

From the observations made since the first appearance of the pest in this country in 1886, there does not appear to be reason to fear serious damage to our Wheat from this attack, *unless* under exceptional circumstances of weather, or from other causes favourable to the increase of the Fly, and unfavourable to the plant-growth. The Barley, however, appears much more liable to attack, and it is very desirable that all reasonable broad-scale measures of prevention, such as have often been advised, should be carried out wherever attack is known to exist.

The brown chrysalids, or "flax-seeds," as they are commonly called, may be easily recognised where they are especially thrown down in the dust, and fine screenings from the threshing-machines, and if these screenings are thrown into wet mud, or burnt, or treated in the way which may be most convenient to destroy them with the contained chrysalids, thus one source of future attack will be thoroughly got rid of.

Rotation of crop which does not include Wheat, and more particularly Barley, are obvious means of fairly starving-out attack in infested districts. Late-sowing of autumn Wheat, that is, not sowing it earlier than is customarily done in this country, is a most important precaution which can hardly be too strongly and too often enforced.

If Wheat is sown during September, whilst the Hessian Fly is still



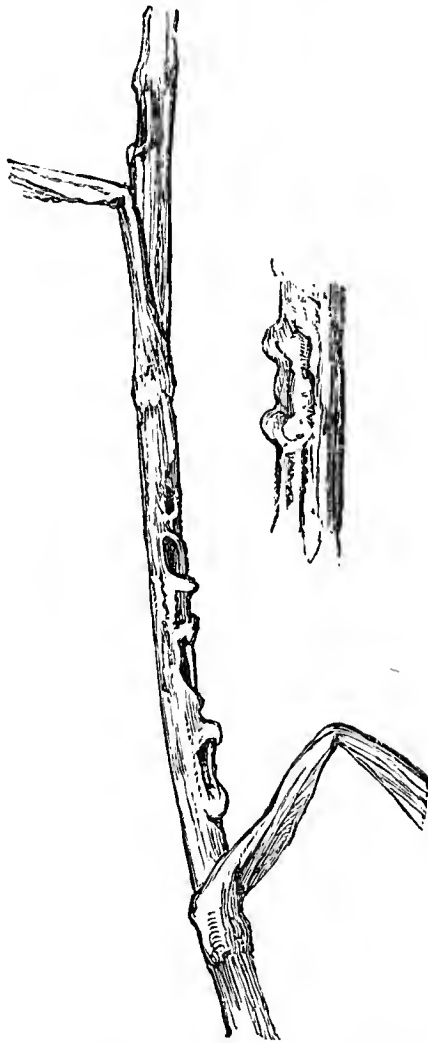
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"Flax-seeds" or puparia in different stages of development, nat. size and magnified.

about, the first up-springing plants will be liable to attack; and if eggs are laid on them, and the maggot establishes itself in the young plant, great mischief will ensue to the attacked crop; and also we should thus establish the extra increase of having a winter brood in addition to those of the warm season.

The remedies for Hessian Fly-attack have been so repeatedly brought forward, that an apology seems almost necessary for mentioning them; but still the great points of prevention should always be borne in mind, namely:—(1st) destruction of infested fine screenings; (2ndly) rotation of crops; and (3rdly) autumn Wheat-sowing at a date that will bring up the young plant at a time past danger of egg-deposit from the Hessian Flies which have developed on the later Corn crops of the season.

Saddle Fly. ? *Cecidomyia (Diplosis) equestris*, Wagner.



Stem of Barley attacked by Saddle Fly red maggots; and a "saddle," mag.

The above sketch of an injured Barley-staw is figured from a specimen forwarded to me during the last season by Mr. J. Eardley Mason, of the Sycamores, Alford, Lincolnshire, from a field in that neighbourhood. This injury was caused by "red maggot," nearly allied to the well-known English kinds found in Wheat-ears or on Barley-stems; but, so far as could be judged by the appearance of the maggots, and the very peculiar method of injury to the straw, the

maggots were of a kind not up to the present time observed in England, but known in Germany as those of the “Saddle Fly,” scientifically the *Cecidomyia (Diplosis) equestris*, Wagner.

The maggots of this species are (at harvest-time) red, with the food-canal showing through the skin as of a darker or black colour; but to general observation they are very like our common “red maggot,” only somewhat larger, the remarkable characteristic of the attack being the peculiar shape of the injuries to the straw.

These, excepting in one instance, where the injury was in the form of a patch of diseased growth upon the surface, were small oval or narrow hollows, with a border of diseased growth, in most cases raised round them, so as to have the appearance of a row of little saddles set along the straw, as figured from a specimen sent. On the left-hand of the straw sketched is a magnified figure of one of these saddles, which, I am informed by Prof. Harker, of the Royal Agricultural College, Cirencester, is quite characteristic of the method of injury of the Saddle Fly. The maggots are stated to go through their changes in the ground. The Saddle Fly Gnat Midge is much like our common Wheat Midge in shape, but larger; also differently coloured. It is described as cherry-red, with yellow hairs, pitchy coloured on the back between the wings, which are transparent, but not iridescent, and are yellow at the base; legs brown.

At present we have not secured the perfect Fly; but it does not seem open to doubt that the attack is of this species, so I record it for further notice, specially drawing the attention of the reader to the observations not being yet complete.

Mr. Eardley Mason informed me that a good deal of “thin” foreign Barley, full of dirt, weed, seeds, and other rubbish, had been sold in Alford Market, and it is very likely the infestation may have been thus transmitted.

“Tulip-root” and Segging; Eelworms. *Tylenchus devastatrix*,
Kuhn.

The Oat-plant disease, known from various peculiarities of deformed growth as Tulip-root, Segging, or Sedging, has now been under special observation since 1886, and if we do not know as yet all that could be wished as to prevention, at least (with the help of continental communication) the nature and life-history of the Eelworm, the *Tylenchus devastatrix*, which gives rise to this attack, is now well known; and so is much of the treatment required to keep it in check, together with the nature and proportion of special dressings which have been found by home experiment to succeed well in preventing or remedying the attack.

In my previous Reports notes of these matters have been given, and in this present one, under the head of "Clover Stem-sickness" (a disease which is caused by the same species of wormlet) additional information is conveyed, to which the reader is referred for minute and full description in detail of the *Tylenchus devastatrix*, together with a plate giving excellent figures, much magnified, of the male and female wormlet, and likewise figures of the wormlet in different stages of development in the egg and in young condition, all copied by his kind permission (for use in this Report) from the beautiful figures drawn from life by Dr. J. Ritzema Bos, Professor at the State College of Agriculture, Wageningen, Holland.*



"Tulip-rooted" Oat-plant.

During the past season notes have been sent of Tulip-root infestation, showing its presence, or prevalence, in various localities, for the most part in Scotland or the north of England, with the addition, in some cases, of treatment, mostly following up points previously brought forward.

Very characteristic specimens of Tulip-root were sent me on July 18th by Mr. Thos. T. Cundy, from the Ainsty Estate Office, Hall Orchards, Wetherby. In this case the Eelworms in the Tulip-rooted Oats were almost unusually numerous and in various stages of growth, and eggs also were observable. Mr. Cundy noted that many Oat-fields in the immediate neighbourhood were badly attacked, and that these were suffering much more than the field from which samples had been forwarded, this field having been fully manured; and he added:— "It has been a hard fight between manure and worms, and the fold-yard manure seems rather to have had the best of it, so that I shall have an average crop, but not such as I should have had without their interference."

* See 'L'Anguillule de la tige,' par Dr. J. Ritzema Bos. Haarlem, 1888. Plates I. and II.

The above observation of Mr. Cundy is quite in accordance with the principles of treatment laid down by Dr. Jul. Kuhn, Director of the Institute of Agriculture, Halle, who advises rich manuring, so long as there is no risk of the Eelworms being *brought* to the field in manure from *Eelworm-infested fodder*.

On April 6th I was favoured by Mr. John Elder, of the Holmes, Uphall, Linlithgow (in completion of his observations of the previous year), with the following short note :—“ My Oat-crop last year was an extremely bulky one, with the exception of one or two spots.” The observations referred to are part of a series that Mr. Elder has been making for four years or upwards, and which have been successively noted in my Reports. The applications to the Oat-land referred to (on which Clover stem-sickness had occurred the previous year) consisted of phosphates, ammonia, and potash, sown with the Oats at the rate of 3 cwt. per acre. This mixture consisted of two parts of sulphate of potash, three parts of sulphate of ammonia, and four parts of phosphates.

As the special plots were reported* up to June 15th, with some additional observations on preventive applications a month later, it is enough to mention here that the unmanured and least-manured parts were worst, and the part treated with sulphate of potash (55 per cent.), 3 cwt. the acre, was excellent at date of special report. Mr. Elder also reported as result of his observations the importance of keeping the land in as high a state of fertility as possible by application of farm or town manure.

The following note, sent me on April 6th by Mr. Richard Brown, of Hillhouse, Kirknewton, Midlothian (who has previously favoured me with observations regarding prevention of Tulip-root disease), draws attention to the beneficial effects of potash, and likewise to the state of the weather requiring observation in application of remedies liable to be washed away by excessive rain, as otherwise only disappointment and loss may follow on the use of the best-approved measures :—“ Tulip-root very prevalent in this district last season (1888). A large field to which we had applied a top dressing of sulphate of potash was badly affected, but the effect of the top dressing may have been diminished by a considerable rainfall which followed its application. We believe that by careful rotation of crops, and the application of potash, as well as the judicious use of gas-lime, we are gradually extirpating this troublesome pest.”

The following notes by Mr. James Harper, of Auchnabo, Slains, Ellon (Aberdeenshire), give some information regarding the benefit of use of Barley, which is a crop not liable to Eelworm-infestation ; also deep ploughing, and also of the manner in which the attack may be found recurring precisely to a line coinciding with former area of

* See 12th ‘Report on Injurious Insects,’ by E. A. Ormerod, pp. 73 and 75.

presence on previously-infected land. The Oat-plants sent me showed very decided symptoms of diseased growth from Eelworm presence, which was mentioned by Mr. Harper as doing great harm to the Oat-crops in that district. Further he noticed:—"I find that to grow a crop of Bere or Barley, in sowing down grass-seeds, prevents the pest on the future lea-crop. I noticed last year my lea-crop continued to be affected immediately where it was last sowed with Oats, just as straight as the plough goes. I fancied last winter that to plough deep might be some help, and have not been so badly affected this year, the infestation being more confined to patches."

In the following, Mr. N. Coates, jun., writing from Hillesden on September 25th, also draws attention to the recurrence of attack, which is only too well known often to happen on infested land, owing to the remarkable life-powers of the wormlets. Mr. Coates desired an opinion regarding treatment of a piece of ground of about four acres, part of a sixteen-acre field on which the last three or four crops of Wheat and Oats had been a failure. The plants were reported to get enlarged at the bottom, and deformed, and after a time to go off. This appeared, from description, to be manifestly a case of Tulip-root, and the succession of crop noted was—in 1885, Wheat, a failure; 1886, Mangolds, a good crop; 1887, Oats, a failure; 1888, Clover, a good crop, mowed twice for hay; 1889, Oats, a failure.

During July, Mr. George Rodger, of Harelaw Farm, Barhead, sent me the following notes regarding prevention of Tulip-root on broken-up lea or grass-land, a matter alluded to above also by Mr. Harper as requiring attention. Mr. Rodger mentioned that Tulip-root in Oats had been more or less in the Barhead district for some time, but was kept in check by the practice of manuring the lea or grass-land when ploughed for Oats, which had been adopted for over six years. This was to sow from 2 to 3 cwt. of superphosphate and $\frac{1}{2}$ cwt. sulphate of ammonia per acre along with the seed; or, before the land was harrowed, 1 cwt. nitrate of soda per acre three weeks after brairding, where necessary.

Prof. A. D. Gilchrist, writing from Bothwell, N.B., mentioned that some fields of Oats in that district were badly affected by Tulip-root (*Tylenchus devastatrix*), and that the disease appeared to be worst where white crops were taken in succession; and a correspondent writing from Dalhousie, near Edinburgh, reported Tulip-root disease to be on the increase in that neighbourhood, which note confirms the observation given by Mr. Elder, of Uphall, Linlithgowshire, last year, of "a great deal of land between this and Edinburgh being infested, probably causing a loss of hundreds of acres of Oat crops."

SUMMARY.—The foregoing notes are of serviceable interest as agreeing incidentally, and in full practice with the points laid down as

a treatment desirable for prevention of Eelworm-infestation. The beneficial effect of good manuring to cause hearty growth, and special manuring with regard to the special nature of the attack, is noticed; but in one case in which an additional dressing of nitrate of soda is reported as being given (if needed), and the whole application is noted as not perfectly effective, I would venture to suggest trying the results of substituting sulphate of potash for the nitrate of soda, as I have before me a trustworthy report of the application of $\frac{1}{2}$ cwt. of sulphate of potash per acre at once checking the Tulip-root disease, and bringing on a good growth where a previous dressing of nitrate of soda had done no good.

The reason why Tulip-root (or Clover-sickness, which is caused by the same Eelworm) should sometimes occur after broken-up pasture is clear, on consideration that the *Tylenchus devastatrix* infests the "Sweet Vernal Grass," "Meadow Soft Grass," and the "Annual Meadow Grass"; and amongst common meadow weeds, the Buttercup, or Upright Crowfoot, the Daisy, and the Ribwort Plantain*; and, as previously remarked, the presence of Barley in the ploughed-up lea would be a *deterrent* of attack, because, as far as we know, it is a plant on which this *Tylenchus devastatrix* never feeds.

The recurrence of the attack, where crops liable to the infestation are sown in succession or at short intervals, is also noticed as a practical observation, and, added to these special notes, the reports of definite amount of loss that is going on from this preventible disease show how desirable it is that attention should be given to the subject.

(For further information, see pp. 6-12, on Clover Stem-sickness caused by *T. devastatrix*, in present Report).

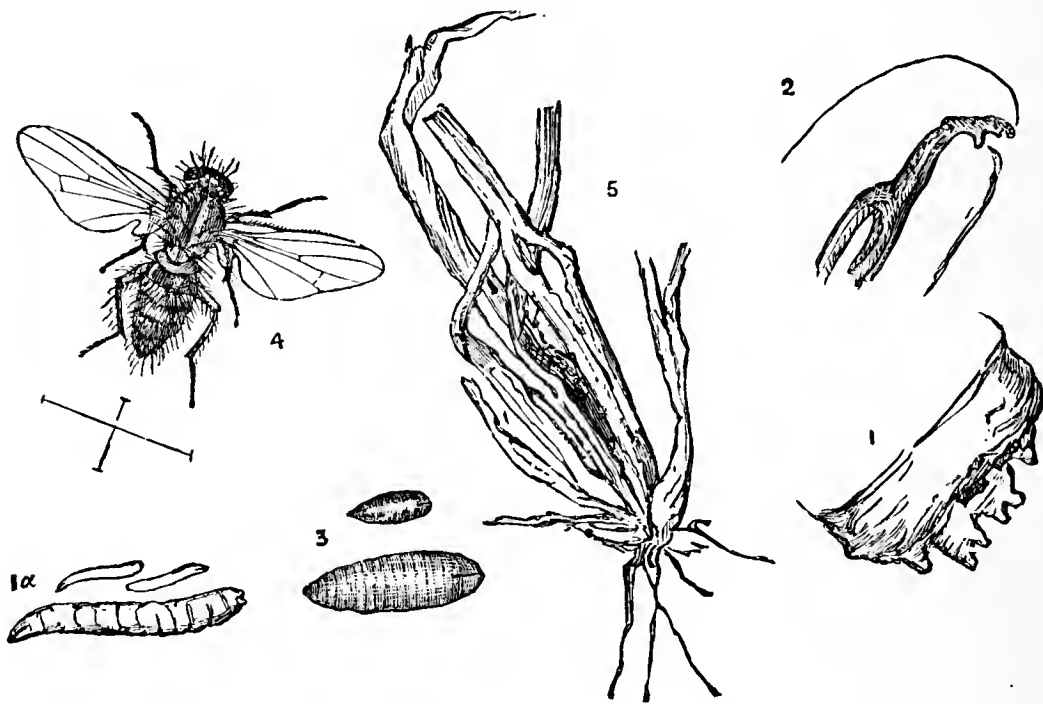
Wheat-bulb Fly. *Hylemia coarctata*, Fallen.

It has not been possible before to add a figure of the *Hylemia coarctata* in its several stages, to the observations of its habits, as the maggots were gone before the flies from them appeared by which we could tell of what species they had been. Now, however, I am able to give the following figure, sketched from English specimens. This shows, at (1A), the shape of the whitish, legless, cylindrical maggot, somewhat pointed towards the head-end, which contains the black mouth-hooks, and apparatus for moving them, figured magnified at (2). At (1), the fleshy tubercles or teeth placed below the caudal extremity, and characteristic of this kind of maggot, are figured much magnified; with a low power these simply appear as a pair of squarish teeth, somewhat concave at the end, with one pointed tooth on each side.

* See 'L'Anguillule de la Tige,' by Dr. J. Ritzema Bos, pp. 66-69.

The chrysalis-case (3) is reddish brown. The fly (4) is of various shades of grey and black, the females having the abdomen, as well as the fore body, of a pale ash-grey, and the four hinder thighs, as well as the shanks, pale (there is some variation in depth of colour of the legs). At (5) a young Wheat-plant is figured slightly torn open, to show the injured centre.

The first specimens of this attack in the past season were sent me on April 5th by Mr. Wm. Parlour, of Middle Farm, Dalton-on-Tees, Darlington. The larvæ were still white and tender, but in the most developed specimens the two squarish central teeth with one on each side were clearly to be seen, and in one instance at least other small



HYLEMIA COARCTATA.

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

teeth outside the two pointed ones were slightly noticeable, as sometimes occurs with this kind of maggot. The centre of the young Wheat-plant was quite cut through within. Of these Mr. Parlour noted:—"I enclose some specimens of Wheat containing a maggot. The maggot is not so large as those of *H. coarctata* I sent last year, but it is earlier, and *may not yet have attained* its full size; the appearance of the field is identical with ours which was attacked last year. I took them from a neighbour's field last night. The greater part of the Wheat is already dead, and there cannot possibly be more than half a crop on it. . . . It was in fallow last year." Somewhat later, that is, on May 2nd, Mr. Parlour furnished me with more specimens, the plants in this case being small and almost eaten out, and favoured me with the following notes, which I give almost *in extenso*, as they convey various points of useful information, some of them confirming previous observations on such points as to special

occurrence of this attack after fallow, and after Turnips, and also where Turnips have failed, a point which has been noticed before, and also dates of sowing, &c.

Mr. Parlour remarked:—"I am sending you some Wheat-plants, in which you will doubtless find some specimens of what is supposed to be the *Hylemia coarctata* maggot. The field I took them from (and there are two others on the same farm quite as bad) cannot possibly yield more than half a crop, and even this moderate calculation is based on a considerable improvement from what it was like at one time. It is after fallow manured with farm-yard manure, and the fallow was after Oats manured in the same way. It was sown about October 15th. A portion that was in Tares last year, when the rest of the field was in fallow, has suffered in a much smaller degree than the rest of the field. There is also a depression in the field, where probably there has been a pond at some time, and this part has not suffered in the least. With these exceptions, the rest of the field is very much alike. I cannot account for these places being better than the rest of the field. Last year I only noticed attacks of the *Hylemia coarctata* after fallow and after Turnips, and this year it is the same. On our own farm we were rather afraid of sowing the fallows with Wheat, and we contrived to get a crop of Rape on them, or sow them with spring Corn in every case but one, and this field we seeded very thickly. I have found a few attacked plants in this field, but no serious damage has been done. The only place where we have any appreciable amount of injury from it is on a small patch of Wheat growing on a place where Turnips missed last year, the rest of the field having suffered no injury. These are the only two fields in which we found any traces of it. The field that was almost destroyed last year we have again sown with Wheat, and it looks well, and has not suffered from the Fly in the least degree. I may mention that the fallow was sown on Oct. 22nd, and the Turnip-land on Dec. 8th, the Wheat sown on the Wheat-stubble where the attack was last year being sown on Nov. 23rd. Another neighbour has a piece of Wheat sown after Turnips badly attacked. It was sown by hand, and the only decent bit of Wheat in the field is a rig he allowed a lad to sow, and the lad put on twice as much seed as he did. This brings me to an important point. The only remedy, not against the attack, but against damage arising from the attack, which I can suggest, after carefully considering the matter for the last two seasons, and adding my own observations to the valuable information contained in your letters and Report for 1888, is a very thick seeding on all lands where the attack is feared; for if the crop escapes, and is considered to be too rank in the spring, a portion of the plants can be harrowed out. In three cases this spring I have found the maggot, after destroying the

old plant, had entered the lateral shoots that often spring from attacked plants; and in one case I found two maggots in one stem. I am confident the pest is much more prevalent in this part of the country than is *suspected*."

On April 12th, Mr. T. Spencer Smithson forwarded on to me from Facit, Rochdale, samples of the same attack as specimens of a larva which was destroying a Wheat-crop on a farm at Ingleby, near Saxilby, in a district a few miles north-west of Lincoln, this being the second season in which the Wheat on the same farm had been attacked by this kind of maggot. Mr. Smithson observed:—"The grub is either hatched in the stem of the Wheat just above the root, or gnaws its way in at that point in its travels upwards. Of course the shoot dies in consequence, and though many of the plants throw out fresh shoots, the damage to the crop is serious."

In reply to my enquiries, Mr. Smithson obliged me with the further information:—"I have learned the following particulars of the fields attacked this year and last by the larvæ of the Wheat-bulb Fly. Both the fields attacked were sown on summer fallows, and on several farms slight attacks were to be seen on crops sown on fallows, but under no other circumstances. Last year the crop was manured with farm-yard manure only; this year the land was limed, and no manure given at all. The seed was got in early, when the land was pretty dry, and the drilling went well, and the seed was deposited pretty deeply. Last year the field was attacked in strips along the north side of the lands which run east and west. I cannot account for this, except on the supposition that the sun has effect on the grubs, which prevents them thriving; but the difference in this case between the north and south sides, with regard to the power of the sun, must be very small, for the lands are quite low."

By May 1st the maggots were well advanced in size. At that date I received two small consignments, in both cases of remarkably fine specimens; some of these—not the largest—were a quarter of an inch long, and fat, strong maggots; and one in each of the stems examined lying lengthways, and so large as nearly to fill it up. In about an hour after placing these maggots on the earth, all but one had gone down into it.

One of the above consignments was forwarded to me from Crosby House Farm, Great Crosby, by Mr. Thomas Pimbley, with the observation that he had only lately noticed the maggot-attack which had destroyed the Wheat-plants sent, but that they were doing great damage to the crop. The other specimens were forwarded to me by Mr. T. W. Collard from Borden, Sittingbourne, with the note:—"The fields of Wheat from which these stems are taken is situated in the Parish of Tong, and the soil is strong loam and brick-earth."

I have suffered the last two years from the ravage of this insect in my Wheat."

A few days after, Mr. Collard favoured me with the following details as to date of sowing, &c. :—

"No. 1. Wheat sown Nov. 15th on Clover-ley; second cut fed off by sheep, and then manured with fish (Five fingers). Attacked with maggot the end of February.

"No. 2. Wheat sown Nov. 17th, after Green Globe Turnip-seed. The Turnip-seed was manured with fish last year. This piece of Wheat is so badly attacked that it must be ploughed up. The attack commenced the end of March.

"No. 3. Sown with Wheat Nov. 24th. Clover-ley; second cut fed off with sheep, and manured for Wheat with best London manure. Attacked the end of February.

"No. 4. Sown with Wheat Dec. 27th, after Cabbage fed off by Sheep. Cabbage manured with sprats. This piece is entirely destroyed."

It will be seen that in this (as in many other instances), especially bad attack followed after Turnips, and also after Cabbage, which is nearly of the same nature.

On May 4th, maggots of the same kind were forwarded to me by Mr. W. M. Chorlton from Withington, near Manchester, with the observation :—"I have had considerable damage done to Wheat, both this year and last, by the insect in the stems of Wheat enclosed. The custom here is to sow Wheat after Potatoes, and we find the insect does most damage on such land as grew Potatoes with light tops, and where the Potatoes are dug early and the soil exposed to the sun in the later part of summer or autumn; whereas the portion of land planted with heavy green-topped Potatoes, and not cleared of the crop until October, generally produces a full, thick crop of Wheat."

Specimens of the *H. coarctata* maggot, apparently just about to turn to the chrysalis state, were also sent me on May 4th by Mr. J. Eardley Mason, of the Sycamores, Alford, from a piece of Wheat at Cumberworth (about five miles from Alford), to which they were doing much damage. In this instance the mischief was reported not to have been noticeable until about three weeks before.

In the following notes by Mr. A. L. Wells, writing from the Warren Farm, Witton, near Birmingham, observation is again given of the curious circumstance of this attack following in some cases where Wheat was put in on ground that had been laid bare :—"Referring to my note to you last year regarding the Wheat-bulb Maggot, I find the Wheat is suffering again this year where sown under similar circumstances, *viz.*, after Swedes, or where Potatoes were got up early. I have also a patch gone off very badly after a crop

of 'Village Blacksmith' Potatoes; the cause, I think, is owing to the haulm being small, and not *covering the ground*; and I think the same cause applies to many of the complaints you received last year, but why it should be so I should very much like to know. I should certainly think a remedy would be found by growing a crop the previous year that would cover the ground, except that it goes after Swedes. I have a field of Wheat this year, after Mangolds, except a small portion sown with Turnips, which failed; and there is hardly a blade of Wheat left on the Turnip-ground, although, after the Mangolds, it looks most luxuriant; it has also gone after Kohl Rabi this year. I have never tried it after Rabi before."

It is very remarkable about the appearance of this attack that it is most commonly observed after fallow, and after Turnips or Swedes, or *where a portion of these have failed*, or sometimes after Potatoes, *where they have been raised before they are ripe, or raised early, or had thin amount of leafage*.

These peculiarities (or more especially the first two) have been regularly observed since the attack was brought under notice a few years ago, but as yet *why* this should be we have not made out; and if we could learn what the one similar point is in the above conditions which attracts the Wheat-bulb Fly, we might expect to be able to use some means of prevention.

Until we got fuller observations, and whilst the "after fallow" crops were still those that were mainly noticed as attacked by this Wheat-bulb Maggot, it appeared likely that this might arise from the Wheat being put in so early that flies of the summer brood were still about at the time when the young plant first sprung, and so they were liable to infestation. This, however, does *not* appear to be the case, as shown by dates of sowing of the crops of the last two seasons. Looking at the dates of sowing of the crops of which failures took place through Wheat-bulb Maggot in 1888, I find these sowings to have been at various dates in October, in the middle and last week of November, and a few places to have been attacked in a crop sown after the middle of December; and in the case of a Wheat-field drilled on Jan. 10th (of which the Wheat was not through the ground until about March 20th), the crop on the part after Swedes was a complete failure.

The dates of sowing which were sent me of some of the attacked crops of last season (1889) were Oct. 15th and 22nd, "early" after fallow; Nov. 15th, 17th, and 24th; and on Dec. 27th a piece was sown which afterwards was entirely destroyed. From these dates it does not appear that late-sowing will avoid the mischief.

The important point which, I think, is to be found existing in the various kinds of condition preceding bad attack is certainty or probability of weed or wild grass presence. We should be extremely likely,

I believe, to have this on fallow; and also in the patches of Swede and Turnip-fields where the crop has failed; and very likely indeed where Potatoes have been cleared early, or before they were ripe. How far the Swedes or Turnips would have been grassy amongst the crop cannot be known without definite report.

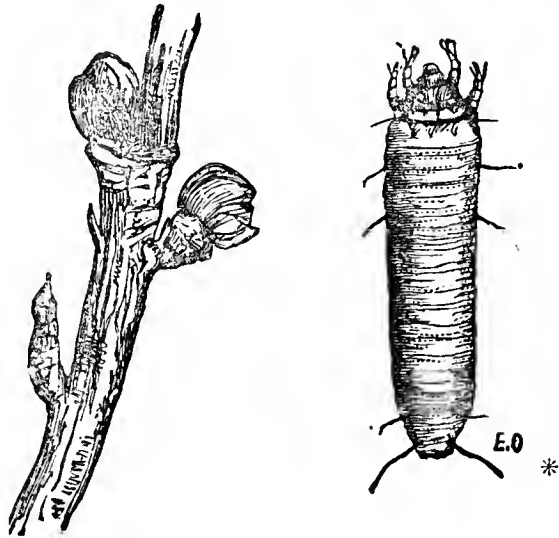
The attack does not seem to be connected with the Turnips themselves, as we have two instances (see my 12th Report, p. 85) of the infestation occurring very badly on land which had been *prepared* for Turnips, but not sown with them, owing to drought.

We cannot make sure, without further observations and examination of specimens, how the case may be, but it would explain all the peculiarities of the observations, and agree with what was to be expected to fill in the history of the attack, if it was found in summer or autumn in young Couch-grass, or other wild grasses, on so-called bare land. This would give the link between the appearance of the Flies in July and the subsequent attack. It is against all likelihood that the identical flies which appear in July should live on to lay their eggs from October to March, but very likely that they should lay them on wild grasses during July, or at least shortly after they appeared; and the maggots from these eggs turning in regular course to chrysalids where they fed would give precisely the missing link that we need to complete the year's observations. They would be where the infested grasses on fallows, or on bare patches, &c., had grown. This would account even for the portions being sometimes so observably marked in area; and I think the following observation, sent me in 1886 by Major Salmon, of Tockington Manor, Almondsbury, Gloucester, bears on this view of the subject:—"It is also to be remarked that the tops of the ridges (*i. e.*, where the soil is the hollowest, from the plough having thrown up the two ridges together from opposite directions) are more affected than the ridges below these or in the bottom." In this case the hollowness would be more favourable for escape of the flies from the chrysalis than the solidly laid earth.

If in the coming season we could have observations in infested districts as to whether young wild grass-plants or side-shoots are seen going off on fallow, or otherwise bare land, in the same way that Corn-plants are destroyed by the Wheat-bulb Maggot, we might lay our hand on the reason of infestation being continued, notably from the above conditions, and gain a clue towards checking this somewhat serious attack.

CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Westwood.



PHYTOPTUS (? SPECIES).

Black Currant shoot with infested buds. Gall Mite enormously magnified; nat. size invisible to the naked eye.

Enquiries have again been sent from various quarters as to any measures which would be really serviceable in putting an end to the bud-gall attack on Black Currants, well called in some places the "Rose-bud" attack. This is caused by the microscopic four-legged Mite figured magnified above, but it is most exceedingly difficult to bring anything to bear beneficially on the matter, as, whilst many of the minute Mites are (where it is almost impossible to injure them) within the swollen buds of the Currants, there are also many widely dispersed about the bushes, or on the ground beneath, and these are also liable to be transported by the feathers of birds, or on wind-borne leaves in autumn.

No advance at all, as far as I know, has been made in the past season as to practicable methods of getting this attack under, and, looking at the nature of the infestation, it seems almost impossible to use any measures of prevention or remedy, excepting such as might be applied in winter, or when the leaves were fallen in autumn, and whilst the buds were still in such minute and embryo state that few of the Gall Mites (*Phytopti*) could have set up infestation.

At this time a coating with lime-wash, such as has been found perfectly useful by Mr. M'Kenzie in the gardens at Glenmuick, N.B., in extirpating White Woolly Scale on Currants (see "Lime-wash" in Index), might very likely do good, so far as it could be applied. The whitewash would lodge in all the nooks and crannies, and kill the Gall Mites sheltering within them; and if the dead leaves which were

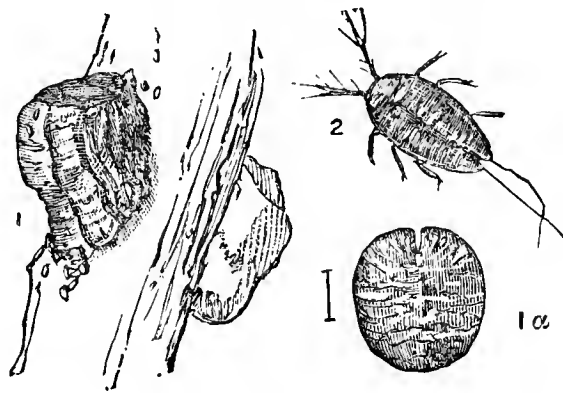
* The above figure shows the general form of *Phytopti*, or Gall Mites.—E. A. O.

knocked off in the operation were raked up and burnt, all would help at least to lessen amount of infestation.

It would not be possible to make use of poisonous applications in the season of leafage and fruit, but there does not seem to be any reason why, in winter, applications of soft soap or Paris-green should not be syringed or sprayed on the bushes by means of some of the various kinds of apparatus now coming into notice.* These "emulsions" would lodge in hollows, and especially above each bud, so as in all probability to prevent these lurking-places being infested.

The above notes, however, are only given as suggestions of treatment which might be of service, and as this attack causes serious loss where Black Currants are grown on a large scale, any information as to means which may have proved useful in checking the Mite would be of much assistance to bush-fruit growers. Notes of the history of the attack, and measures for extirpating it, when on only a small scale, have been given in previous Reports.

White Woolly Currant Scale. *Pulvinaria ribesiæ*, Signoret.



PULVINARIA RIBESIÆ.

1, Female and woolly egg-sac, mag. (nat. size given at p. 45). 1A, female scale, mag., with line giving nat. length. 2, larva, magnified.

The accompanying sketch (see p. 45) is taken from a photograph of a Currant-bough infested by the White Woolly Currant Scale, the *Pulvinaria ribesiæ*, Signoret, a kind of attack which is known in France, but which, although we now find that it has been present at various places in England and Scotland during the last few years, has not been scientifically identified and recorded as present in Britain until June, 1889.

On June 18th, specimens of the attack were sent me from the garden of Mr. George Parkin (by whom they were first observed at Wakefield), by Mr. S. L. Mosley, Beaumont Park Museum, Huddersfield, with a note that it evidently "seemed at home where it was established, and that the Red Currant-bushes were terribly affected by it"; and

* See "Emulsions," "Paris Green," and "Cyclone nozzle" in Index.

he drew my attention to the very great number of eggs in the cottony matter surrounding the Scale.

The specimens were submitted by Mr. S. L. Mosley to Mr. J. W. Douglas, of 8, Beaufort Gardens, Lewisham, S.E., for authoritative identification, who reported on them as follows:—"The Coccids you sent are *Pulvinaria ribesiæ*, Signoret ('Essai sur les Cochenilles,' p. 219), a species found on Red Currant-bushes in France, and which I have long expected to hear inhabited Britain, but until now I have not seen it." As this kind has not as yet been brought forward here, I append in a note* a translation of Dr. Signoret's scientific description. My own more general description, from specimens examined on June 2nd, is as follows:—

The scale itself (see fig. 1A) dark grey-brown, rather longer than broad (the specimens measured from one-eighth to three-sixteenths of an inch in length, and over one-eighth of an inch in width), of a squarish oval, with the hinder extremity notched or heart-shaped, and in their then dried state the fore part turned up so much as to be reflexed; the keel along the back was still partly observable, with slight ridges running down to the edge of the scale.

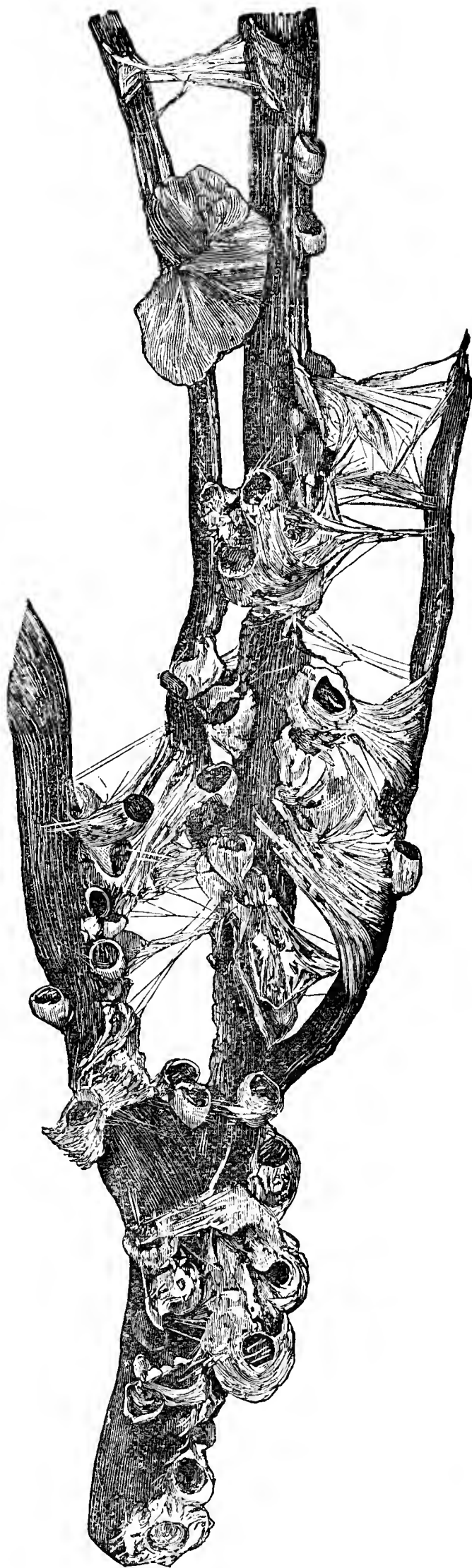
The white cottony or woolly matter (figured at 1, p. 43) which forms the nest of the eggs, and of the young scales in their earliest condition, formed, where it was undisturbed, a compact tuft, on the front part of which the scale itself was raised, sometimes almost vertically. Whilst fresh, the scale and its white wool formed together a somewhat oval mass, which presently became drawn out in all directions, so that in the distance the infested branches looked as if they were scattered over with whitewash (see accompanying figure from a photo kindly taken for me by Mr. T. P. Newman, of 54, Hatton Garden).

* "In its most advanced stage, this species, which is nearly allied to *P. vitis* and *P. oxyacantha*, is 4 millemetres long by 3 broad, not including in this the white cottony matter, which may vary in extent according to the state of growth of the embryos which it contains. The scale is of a reddish brown, with a line more or less raised on the back, which gives it almost the appearance of being keeled; on each side of the body it is wrinkled, and faintly pitted; in a dry state the folds are hardly observable—it might be said to be smooth. It is nearly allied to *vitis*, but smaller, thicker, rounder, more heart-shaped, and of a deeper brown; *ribesiæ* is distinguished from it, especially in the embryo state, which is longer, with the members thicker, the tarsi and tibiæ much shorter, and half less in size in *P. ribesiæ* than in *P. vitis*, and the large hair which is observed on the tibia in almost all the species is very much longer in this one; the antennæ, almost of similar form, have fewer long hairs; thus in the embryo of *Pulvinaria vitis* six are observable, whilst in *ribesiæ* there are only five, of which that of the third article and that of the disc of the last article are much the longest, the great hair at the extremity of this article being a good third shorter than these. With regard to the cottony matter which is observable, it is very abundant in this species, and entirely of the same nature of that of *P. vitis*."—"Essai sur les Cochenilles,' 15, *Pulvinaria ribesiæ* nobis, par M. le Docteur Signoret. p. 219 (vol. i. of Collected Essays).

The egg-like bodies in the wool, when examined at this date (July 2), proved to have hatched, and these orange-coloured larvæ were dispersing themselves in vast numbers in the box in which the spray of infested Currant sent me by Mr. Mosley was secured.

These very active young scale-insects (fig. 2) were whitish or orange in colour, of a flattened oval shape, broadest near the head, deeply cleft at the caudal extremity, with a long hair or filament on each side of the cleft, that is, one long filament placed on each lobe caused by the cleft, and in the centre of the cleft a long, cylindrical process. The body somewhat raised along the centre, with slightly indicated corrugations along it, and side ridges from it, and the surface slightly sprinkled with white or woolly morsels. Eyes dark or black. One of the special characteristics by which this species is known is the number and length of the hairs on the antennæ, but in the size figured I have only been able to indicate that hairs are present.

A few days after Mr. Mosley had forwarded me the specimens from Wakefield, his attention was drawn to the presence of the Scale to a large extent, and to all appearance doing definite injury to the Currant-bushes in a garden adjoining his own at Huddersfield, of which he wrote me as follows:—"There is a row of about forty good-sized bushes against a wall, all of which are



Currant-branch infested by White Woolly Scale,

more or less affected, and *many* of them quite as thickly covered as the bit I send. The insects have not been noticed before, and were certainly not there when the bushes were shifted about two years ago. They are in a very exposed situation, facing the north, and have never been very productive in fruit. I think, however, that these insects *must* do damage. Where a bush had more Coccids on one side than the other, I noticed that that side would frequently have a number of dead branches; some of the branches, either dead or partly dead, had withered leaves at the top, showing that they had leafed in the spring, and had been then alive. These bushes, I should say, are all *black* Currants, though where I found them at Wakefield it was on *red*."—
S. L. M.

About the same date, specimens of *Pulvinaria ribesiæ* with great quantities of eggs or young larvæ were forwarded to me by Prof. Geddes, University College, Dundee, with a letter accompanying from Mr. W. Cruickshank, 10, Clergy Street, Macduff (Co. Banff, N.B.), requesting information about it as a form of life unknown to him, which was infesting his Currant-bushes, and threatened to spread.

On first hearing of the newly-noticed Scale, with examples accompanying showing its vast power of multiplication, I advised burning the infested bushes, that the attack might be at once stamped out before (like the Currant Gall Mite) it established itself to a serious extent; but shortly after the observations began, I was favoured with the following valuable information as to simple measures which had been found to act perfectly well in extirpating the pest, without injuring the bushes:—

On July 21st, Mr. Wm. M'Kenzie wrote me from the gardens under his charge at Glenmuick, Ballater, Aberdeenshire, that in 1880 the garden was visited by this Currant pest, and, as he had never, after a long experience, seen it before, he first tried the common application of soft-soap as a remedy. This proved useless, as also did dilute paraffin-oil, which, as Mr. W. M'Kenzie justly remarks, is an application not generally to be recommended, as it may do much harm if not judiciously used. These applications having failed, in the following year (1881) Mr. W. M'Kenzie "applied a dilution of hot lime in the autumn, going over the bushes with a brush (the same process as whitewashing), occasioning the bushes to shed or throw off the bark, and thus effectually curing them of the pest, without in the least injuring the bushes." The proportion used was "two pounds of lime to one gallon of water, being the same consistency as is used for whitewashing walls." This application Mr. M'Kenzie found to be an effectual and permanent cure, and later on he forwarded me specimens of Currants gathered off the previously-mentioned bushes to show that the remedy had proved thoroughly effective against the infestation,

and had done no harm to the plants. I can bear witness to these Currants being magnificent specimens, the berries numerous and large, and excellently tasted. It would have been difficult to find better examples of good growth. Both Red and White Currants were sent.

The following memorandum from Mr. J. Sim (Market Gardener, Stonehaven, Kincardine) gives the date of his first observation of the Scale in that neighbourhood:—" . . . If I understand it aright, the enemy is not new to our country, although the knowledge of it may be. Six years ago I observed a bush of the Flowering Currant, *Ribes sanguineum*, looking very sickly, and, on examining, I found the under side of the branches all covered with the cottony mass you mention (which I took to be a fungus), but, on examining, saw it was connected with animal life. The bush died the following season. I do not know if it has spread further about Aberdeen or not. Two years ago I observed it on Red Currant-bushes nailed to the wall in a little garden in Stonehaven; a part of the wood was dead, which I cut out; the rest of the bush is mostly covered with it now. There are Black Currant-bushes which it has not touched."—J. S. Specimens were sent accompanying.

I had also information sent me from Edinburgh on July 10th, with specimens accompanying, of the presence of the *P. ribesiæ* on Red and White Currant-bushes in a garden in Leamington Terrace. In this instance the infestation had been first observed in the beginning of June, 1889, and as the writer mentioned not having been able to procure any information on the subject, it is presumable that the attack was not at least noticeably present in the neighbourhood.

On July 27th a branch of Red Currant infested by this same White Woolly Scale was forwarded to me from Arbroath. In this instance the infestation was slight, and the sender observed that he only found the *P. ribesiæ* on plants not fully exposed to the light and air, but he was informed by others in Arbroath that the whole of their bushes had been attacked.

On August 23rd specimens were also sent of this same attack by Mr. F. W. Norman, of Cheviot House, Berwick-on-Tweed, who a few days later visited the garden from which they were forwarded, and wrote me that he found the whole of the Currant-trees in the garden, Red, White, and Black, infested, and many of them thickly studded with the woolly nest of the Scale-insect. The garden was very near the sea, and it was stated that the attack first appeared five years ago, but, as far as the owner knew (or could then be learnt), it had not appeared in any other garden.

Washing the branches carefully with soap-suds had been tried, but (as noted previously, with regard to soft-soap wash, at p. 46) without permanent benefit.

Besides presence of *P. ribesiæ* on Currant-bushes of various kinds, as noted above, there appears some reason to think that this species, or one, so far as we see at present, indistinguishable from it, is occasionally to be found on the "Mountain Ash" tree, the "Rowan" tree of Scotland, *Pyrus aucuparia* scientifically.

Mr. Mosley, writing to me from Huddersfield, mentioned:—"On Saturday, June 22nd, during an excursion of our Society to Norland Moor (near Halifax), one of our members discovered what appears to be the same or a very similar Coccid." Of this Mr. J. W. Douglas noted, on specimens being submitted to him:—"The *Pulvinaria* is not distinguishable from *P. ribesiæ*." I had also a note of a somewhat similar attack being observed on a Mountain Ash in the parish of Leslie (Aberdeenshire), but as in this instance the infested tree was (very wisely) at once cut down and burnt, to save risk of damage from spread of infestation, the attack was not fully identified.

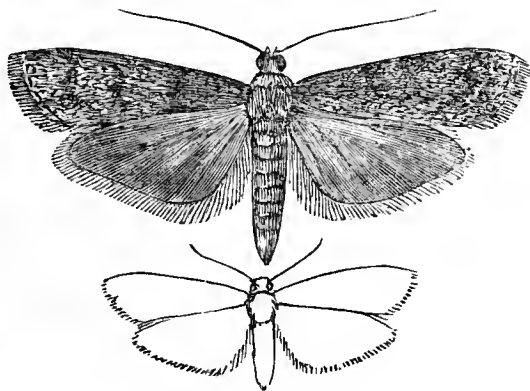
SUMMARY. — From the foregoing notes it appears that this White Woolly Scale infests Black, Red, and White Currants, and also the ornamental kind commonly known as the Flowering Currant; possibly also is found on the Mountain Ash. Although the first duly identified observation of the appearance of the *P. ribesiæ* in this country did not occur until the past season (1889), yet an attack which is now recognised as the same was observed so far back as 1880; and notes from various places accompanying specimens sent mention the senders having known of the presence of the infestation for two, five, or six years previously, though they did not know its name. It is somewhat curious that, of these Currant-attacks, with the exception of the infestation at Wakefield and Huddersfield (and that at Ballater, which is not very far inland), that the rest should be on or near the sea-coast on the East of Scotland, namely, in the neighbourhood of Banff, Aberdeen, Stonehaven, Arbroath, Edinburgh, and Berwick-on-Tweed.

The plants, or parts of plants, most affected (where specially reported) were bushes nailed to walls, or not fully exposed to light and air, or the under side of branches, and the amount of injury that *can* be caused by this attack shows that it is of a nature that requires to be kept in check. The simple and commonly useful measures of washing with soap, or soft-soap, are noted as complete *failures*, as also the application of dilute paraffin-oil; but, on the other hand, the plan of whitewashing the infested stems in winter, given on the good authority of Mr. W. M'Kenzie as the result of his own experiments (p. 46), appears to have acted so well as at present to leave nothing more to be desired in the way of winter extirpation. But still in the cases of summer presence, where this remedy could not be brought to bear, and in case the bushes could be sacrificed without serious loss, it might be but a prudent course (looking at the great inconveniences of new

infestation taking hold) to burn these infested bushes as soon as the white patches were observed, and so stamp out the danger at once.

FLOUR MILLS AND STORES.

1812 Flour Moth. *Ephestia Kuhniella*, Zeller.



EPHESTIA KUHNIELLA.

Flour Moth, magnified; outline showing nat. size.

The attack of the Flour Moth is an instance of the very unusual circumstance of an infestation which *up to a certain date* was so far unknown that the insect causing it was undescribed, and the mischief itself unrecorded; yet, having proved subsequently to this date of very serious importance, and gradually extending its presence (at recorded dates of observation) in Europe, and subsequently (whether the kind was originally there or not) making a very injurious appearance in N. America.

In 1877 this Flour Moth was first observed by Dr. Jul. Kuhn, Director of the Agricultural Institute, Halle, Germany, and specimens were identified by Prof. Zeller as being of a kind of *Ephestia* undescribed up to that time, and to which he gave (in remembrance of its observer) the specific name of *Kuhniella*.

The attack is recorded as present in Holland in 1879; in 1887 it appeared in England. It did great damage in some large Flour-warehouses in the East of London, where the origin of the outburst was considered to be from Meal shipped from Fiume, on the Adriatic, two years previously. It was also mentioned by Mr. Sidney Klein "as a scourge of the Mediterranean ports," but, so far as I am aware, without any date being given for its first observation there.

In 1888 I first made acquaintance with this new pest, as a most serious visitation in a steam Flour-mill so many scores of miles from London that there was no reason to consider the infestation had been passed on from thence, and with a view of tracing the origin of the evil to its source, I made enquiries as to observation of presence of the insect in other countries,

Dr. Lindeman (Prof. à l'école Agricole, Moscow) favoured me with a reply that he was not aware of it being present in Southern Russia, but he could take upon himself to say that in Central Russia it had not up to that time been observed.

Whether this species of *Ephestia* has been present in N. America until its outbreak at Toronto in 1889 I cannot state with precision, as the official report is not yet in my hands. From returns sent me up to the early part of last year, there appeared no reason to consider this to be the case. But the further investigation which has been set on foot has, I am informed, shown it *has* been present for some years. If possible, I will give details on this point in Appendix. There are few injurious insects of which the attack is so obvious when present as that of this Flour Moth, because, when it does come, the legions of caterpillars webbing up stores, or spinning and felting up Flour till much apparatus is choked and the whole place infested, make the establishment of the pest too plain for the date of the trouble to be doubtful, and on August 20th, 1889, I received a letter from the Dominion Entomologist, Mr. J. Fletcher, informing me that the *Ephestia Kuhniella* had appeared in some large steam mills in Ontario, and was doing severe damage.

In my 12th 'Report on Injurious Insects,' details were given as to the nature of the attack, but the following short abstract of information may be of service to those not previously acquainted with it:—

The *Ephestia Kuhniella*, or Flour Moth, is of the size figured at p. 49 in outline; the markings are represented in the magnified figure accompanying. The colour of the fore wings is of a rather pale grey, with darker transverse markings; the hind wings are whitish and semitransparent, with a darker line from the point along the fore edge.

The Moths lay their eggs on Flour, or "branny stuff," or on sacks where Flour is stored (this last point being a very important one relatively to spread of infestation from centres such as bakers' establishments, where infested sacks may transfer the presence of pest to clean ones, and so distribute the trouble through a whole district.

The eggs have been seen to hatch in a few days in England, and the caterpillars, which amongst those sent me ranged from about two to five-eighths of an inch in length, were 16-footed, cylindrical, and somewhat slender, varying from a fleshy or pale red in the younger to almost white in the older specimens. The head was yellowish brown, with darker jaws, and on the segment behind the head was a pale yellowish brown patch divided from back to front by a faint line, and above the last segment there was also a brownish oval or triangular patch; along the back there were dark dots, for the most part four on each segment.

These caterpillars turn to chrysalids in silken cocoons spun in the Flour in which they fed, and from this stage the moths are stated to come out in three weeks, but I had not the opportunity of noting this myself; one great reason for the almost overwhelming amount of injury rapidly caused by this attack is that it is the nature of the caterpillars whilst feeding in the infested flour to spin it up into such complete clots that the lumps may be lifted up as if felted together, and thus in stores they do great harm by working in the outer part of the Flour to which they have penetrated through the sacks; but where they once get established in Flour-mills, the loss by reason of stoppages of machinery, and their presence in every nook and cranny where Flour may have been blown, is a matter which in a very few weeks may be counted by hundreds of pounds of expense.

On application for advice being made to me by the owner of the steam mills in this country where one of the first serious attacks of this devastating pest occurred, the best suggestion which I could make to meet this new difficulty was turning on hot steam sent by pipes from the engines into every accessible spot, and this and fumigating by burning sulphur to destroy the moths, and some other more general measures, have done much good—first, to clear out attack, and secondly to prevent its recurrence to a serious extent, and to prevent spread of infestation. Also I did my best to caution those concerned on the immense importance of baking their sacks, or otherwise making sure that in the transit of these to bakers' establishments, or other possibly infested places, that they should not bring infestation home with them on their return.

But in this my work was most difficult, because my advice was asked in business confidence; consequently I had no right to make the locality of infestation publicly known, or warn the surrounding district, though, by taking this as part of what might be generally in danger, I did what I could to save it. Now, however, the outbreak of this Flour Moth in Canada allows me to bring the importance of the matter and the stringent nature of the remedies required more markedly forward, and, as I was honoured by being called into consultation on the subject by the Department of Agriculture of Ontario and the Dominion Entomologist, and likewise had communication with the steam millers whose premises were infested, I have thought it well for public service here to give the following useful information lately placed in my hands, in addition to that previously given by myself in my 12th Report.

This, it will be seen, includes observations of the first appearance of the Moth in Canada, the rapid development of the mischief, the immediate attention paid to it by the Government and their eminently qualified advisers, the measures first used, and, on these being in-

sufficient, the further measures taken under an order from the Lieutenant-Governor; and I beg to acknowledge with thanks the courtesy of the Department of Agriculture of Ontario in furnishing me with copies of their exhaustive report on *Ephestia Kuhniella*, from which the following paragraphs in small type (marked as extracts) are given below:—

First appearance of the Moth, and observations of spread of infestation:—

“The following statement is made by the manager of the mill in this Province in which the pest first appeared:—

‘The first appearance of the *Ephestia Kuhniella*, or Flour Moth, that we remember seeing was during the month of March last, 1889. The moth was seen flying about near a steam-pipe in the basement of the mill, and near the w.c. Little attention was paid to it, as from appearance it did not indicate any danger. In April there was an appearance of a few moths on the different floors of the mill, even at the top, but still there was nothing suspicious. In the month of May we were troubled with a few worms in some of our goods, and in June more of them appeared. In July they increased rapidly, and then we began to suspect they were from the fly which we had seen in the mill during the previous months, and which was steadily increasing in numbers. About the middle of July we shut down for a day or so, took the clothing from our bolting-reels, and cleaned it and washed the inside thoroughly with soft lye-soap and lime. We did the same with the elevators. When we started up again, every corner and part of the mill had been thoroughly cleaned, as we supposed, and we commenced to work again, but after about four days we found our bolting-reels, elevators, &c., worse than before. They were literally swarming with webs, moths, and worms, even inside the dark chambers of the reels. We shut down again, and made a more thorough cleaning by washing, &c. While this was going on, we found there was no use to try and clear ourselves of the pest, as the mill-walls, ceilings, cracks, crevices, and every machine was completely infested with moths, cocoons, and caterpillars, and there was no use going on. It then occurred to us that a plague like one of the plagues of Egypt was upon us. The moth was different to any of which we had had any knowledge or experience, and we decided to apply to the Dominion Government for relief and assistance.’”

Attention was given to the subject by the Department of Agriculture of Ontario, and their advisers, including the Director-General of the Experimental Farm Stations and the Entomologist of the Dominion:—

“We addressed the Government Entomologist, Mr. Fletcher, and sent him samples of the moth, caterpillars, webs, &c., and received a prompt answer, which considerably alarmed us. This letter was followed by others almost daily from Mr. Fletcher, and a visit from Prof. Saunders on August 17th. Mr. Fletcher visited us also on August 27th, but in the meantime Mr. Blue, the Assistant Minister of Agriculture for Ontario, visited us, and took in the whole situation. It was explained to Mr. Blue that the Dominion Government had been appealed to by us, through Mr. Fletcher, the Dominion Government Entomologist, for assistance and remuneration for the loss we had sustained. Mr. Blue, considering it to be a matter with which the Local Government had to do, brought Dr. Bryce, the Provincial Medical Inspector, and submitted the matter to the Government for

action. Afterwards Dr. Bryce and Prof. Fletcher came together, and finally the whole matter was left in charge of Dr. Bryce and the Provincial Board of Health."

Measures of purification by steaming and fumigation:—

"In the meantime we took down our machinery, and subjected it to steaming. Every part was thoroughly steamed. The mill was swept down, and subjected to sulphur-fumes. The walls, ceilings, &c., were cleaned, and elevator-spouts and loose wooden work burnt up. Paper bags and hundreds of dollars worth of goods were burnt in the furnace, while the other bags, elevator-belts, and cups were boiled for hours in a cauldron of water. The machines and all parts that were not destroyed were then burnt by means of a kerosene torch, which flamed and smoked through and around every part of them, until we considered we had everything clean and ready for putting together again."

More stringent measures enforced by an Order in Council approved by His Honour the Lieutenant-Governor:—

"But on September 19th the Local Government passed an Order in Council compelling us to take more stringent steps, or rather ordering the Provincial Board of Health to take immediate steps for the suppression of the pest. This Act was approved of by His Honour the Lieutenant-Governor, who signed the Order in Council, and on September 20th we received an order from Dr. Bryce which stated that before placing our machinery in position we should subject it to a thorough disinfecting process in a strong room so arranged that steam under pressure might be drawn or driven into it."

Further measures to allow application of steam pressure to the machinery:—

"In compliance with this order, we at once constructed a tight steam-box, 6 ft. wide, 6 ft. high, and 12 ft. long, and attached a steam-pipe to it from the boiler. In this box we put every machine, and even our mill-stones and iron rollers. This process was very expensive, and took up considerable time, as we were over a week at the process, and were delayed in the placing of our machinery. The Board of Health visited us in a body during the time this process was going on, and pronounced it a success. This was all done not only in our own interests, as was pointed out in the letter of September 20th from Dr. Bryce, but in the interests of the public health and commerce of the country.

"Having now got to the position which enables us to go to work again, after two months' loss of time, and the loss of machinery, fixtures, stock, and expense, we have arranged for remedial measures to prevent the reappearance or destruction of the pest, should we ever be again attacked."*

(In a letter written to myself from the owners of the infested Canadian Steam Mills on Sept. 21st, 1889, the loss up to that date was stated to be about £1000.—E. A. O.)

Returning now to the consideration of the pest in this country, I am aware of it being still present, and that in one instance it is being kept in check by frequent fumigation, of which I believe sulphur

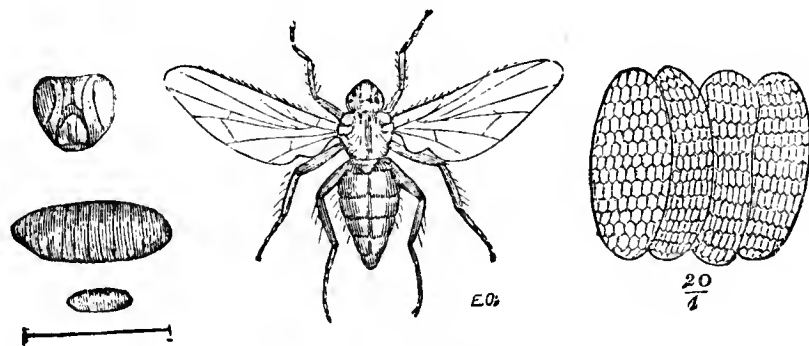
* The above quotations are taken from 'Bulletin 1, Provincial Board of Health of Ontario. The Flour Moth, *Ephestia Kuhlmanni*.' Issued by the Ontario Department of Agriculture.

is the main ingredient. Also, to the best of my belief, there is nothing like the care exercised which ought to be in precautionary measures. I know that one time the maggots, from whatever source derived, were only too noticeable in one of our county towns, and also the practice of some entomologists of keeping large numbers of the maggot for observation, but without the slightest care as to where they may stray to, is full of risk to all their neighbours who may be connected with Flour-dealings, whether bakers, store holders, or millers. This point should be all the more scrupulously guarded against because the mischief caused is not brought forward. No one, whilst there is a chance of avoiding it, will announce his own mills or stores to be infested! and the consequent difficulty of consulting with other millers or specialists on the subject is one reason why I have brought forward *verbatim* some of the most important practical parts of the Canadian Report, which gives, from the high authorities quoted, the approval of the same class of measures which, though not on such a perfect scale, we practised here in the infested mills on which I previously reported.

The precautionary measures: (1) That all who know they have the infestation (whether their neighbours know it or not) *should not* spread it, in maggots, flour, meal, or sacks, is one important point; and (2) that all who see reason to have the slightest doubt of infestation being about, should brush, or bake, or expose return-sacks to hot steam, would do much good. With regard to washes, or special kinds of fumigation, or other measures found serviceable in checking attack of this Flour-pest, or reasonably likely to be so, I shall be happy to give information to any applicant, from the copy yet remaining in my hands of the Canadian Report, or from my own (though less perfect) work in this country.

MANGOLDS.

Mangold or Beet Fly. *Anthomyia betæ*.



ANTHOMYIA BETÆ.

Fly, female, mag.; line showing spread of wings, nat. size; head and cluster of eggs, mag.; chrysalis, nat. size and mag.

Mangold-leaf Maggot appeared at various places, but very few reports of it were sent to myself, and no notes of methods of prevention or remedy having been tried.

Prof. W. M'Cracken, writing from the Royal Agricultural College, Cirencester, mentioned:—"The Mangold Maggot was very prevalent in the first half of June, but the damage done, owing to the rapidity of growth at that time, was hardly appreciable." This point of rapid growth is, *as far as we see at present*, about the only way by which the effects of this kind of Maggot-attack can be reliably counteracted. Pinching out the infested parts of the leaves, and crushing the Maggot in the blistered or dead patch which it has formed by gnawing away the substance between the two sides of the leaf, is a very great preventive of a succeeding attack taking place; and so also is hand-drawing the infested plants, as in both these cases, if the plants or pieces of leaf are destroyed with the Maggots in them, we necessarily get rid of the flies that they very soon would have turned to. But the operations are tedious and expensive, and, unless the workers are well looked after, they are almost useless, for if the infested plants are left undestroyed, the Maggots within (or many of them) will go through their changes without having suffered. Dressings of various kinds have been found to do good, but the difficulty has been *up to the present time* how to apply them; *as time goes on*, it seems likely that if the "Strawsonizer" should be got to work, that this is just one of the kinds of attack to which its work could be usefully applied. The deterrent fluid dressings, which would ruin the leafage in ordinary hand application, might thus be distributed evenly and thoroughly on both upper and under side of the leaves, or, if preferred, dry dressings might be similarly applied, and the utter disturbance caused amongst the plants (necessarily accompanying the application) could not fail to rouse out many of the flies that were amongst the plants to receive a share of the dressing. I should greatly hope that this would do very much good, but, until then, the best hope seems to be in a good hearty growth that will keep the plant well up by supply of new leafage more than counterbalancing that which has been destroyed by the Maggot-blisters.

The attack (as is well known) is caused by the fly laying her eggs on the Mangold- or Beet-leaves, from which the Maggots creep into the leaves, and there feed, causing the well-known great blisters, sometimes spreading over several inches of the leaf. They come to full growth in about a month, and may then turn to chrysalids in the leaf they have injured, or may drop from it to go through the change in the earth beneath. The flies appear (in summer) in about a fortnight, so that there may be several broods during the warm season; but as the Mangold-leaves are much stronger and larger by the time the later broods appear, the damage is very much less at this period than when the plants are in their first growth.

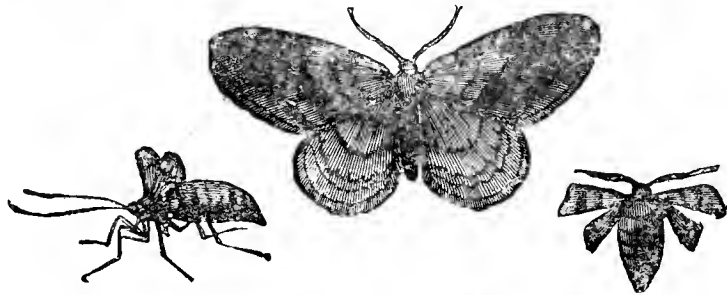
The little patches of snow-white eggs do not seem to be often

observed, as they are generally laid on the under side of the leaf, and the eggs are very minute; but in the earlier part of August specimens were sent me by Mr. J. Swallow from Newcastle-on-Tyne, which, when seen under a microscope, were beautifully figured over with the characteristic, somewhat honeycomb-like markings figured at p. 54. These were laid in small clusters on Beet-leaves, and the Maggots were noted as causing much damage, "nearly destroying" the enquirer's crop of Beet.

Another enquiry was sent from near Banbury regarding attack of the same insect on Mangold-leaves, but without report of amount of injury caused.

ORCHARD INSECTS.

Winter Moth; **Evesham Moth,** *Cheimatobia brumata*, Linn.; **Mottled Umber,** *Hybernia defoliaria*, Linn.; **March Moth,** *Anisopteryx ascularia*, Wien Verz.; and other common species.



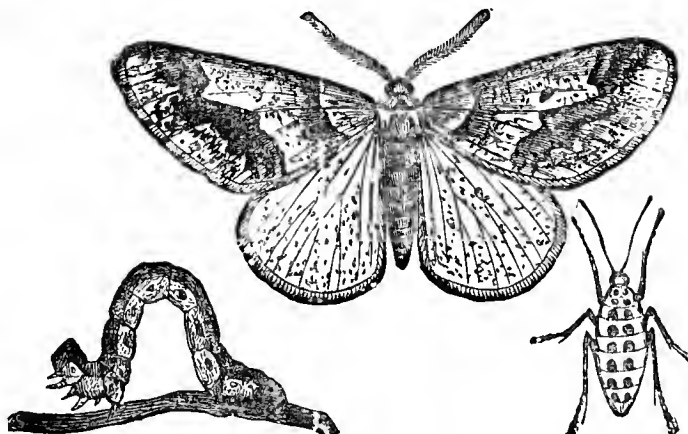
CHEIMATOBIA BRUMATA.

Winter Moth; male and wingless females.

During the past season, as well as in that of 1888, insect-attack of various kinds was present to a serious extent on orchard fruit-trees in various parts of the country. The worst accounts which were sent to myself were from Worcestershire and Gloucestershire, and some also from Kent; but individual enquiries were also sent from localities widely separated, as from near Liverpool, and from near Ampthill, in Bedfordshire; and also much damage was reported from near Barking, in Essex, and notes from other places showed that the insect-injury was not confined to the fruit-growing districts. Likewise in the past season, as well as in the previous one, few, if any, enquiries were sent to me regarding orchard-insect presence from Devonshire or Somersetshire, and if the ravages which did so much harm in various other parts of England spared these counties, the reasons for this would be well worth investigation.

The most injurious and most widely-spread kinds of attacks were, as before, those of the Winter Moth caterpillars. The web-making caterpillars of the Lackey Moth and the Small Ermine Moth were also

present, and also the brown and yellow "Looper" caterpillars of the Mottled UMBER Moth (see accompanying figure).



HYBERNIA DEFOLIARIA.

The Mottled UMBER Moth; male, female, and caterpillar.

The "Blue-head" caterpillar of the Figure of 8 Moth was again sent from various places, and the wingless females of the "March Moth" (then in the act of laying their broad bands of eggs embedded in down, on the sprays of the fruit trees) were forwarded at the end of March. The little "Red Bud Caterpillars," which turn to very small moths, easily known by a broad whitish band placed across the centre of the fore wings from one side to the other, were found in one locality on Apple, and various other Moth-caterpillars shared the work, but were not so specially observed.

The "Apple-blossom Weevils" were reported as being remarkably injurious near Swanley, in Kent, and the White "Woolly Aphis" attack (commonly known as "American blight") was enquired about from Dundee, under the impression that it was showing spread of the recently-noticed White Woolly Currant Scale (see pp. 43-49) to Apple-bark.

Some remarkably healthy and well-grown specimens of the large wood-boring caterpillars of the Wood Leopard Moth were also sent me in the bored Pear-branches.

Of the above attacks, those of the Winter Moth caterpillars are much the most important, both on account of their destructiveness and the variety of trees on which they feed, and it is satisfactory to find that the measures which have been used to keep them in check have proved, *when carried out carefully and in good time*, to be of real service.

As is well known to most orchard-growers, the point of the history of this Moth which places it to a great extent in our power is, that the wings of the female are so stunted that they are useless for purposes of flight, consequently the Moth is obliged to creep up the trunks of the trees, instead of flying through the air, to gain the branches or twigs where she may wish to lay her eggs.

On this turns the whole system of checking attack by bands of grease. If rightly done, and at the right time of year, it is an excellent

means of preventing much mischief, and each orchard-owner may see for himself, by counting the Moths stuck fast in the grease, how far the application has lessened the amount of coming infestation on any one tree. The plan is also equally useful for stopping traffic up the trees of other moths of which *the females are wingless*, as, for instance, of the Mottled Umber Moth, which comes out much at the same time as the Winter Moth, so that the same greasing answers as a preventive of the two attacks. But it is needful to know at what time of year the moths come out (as, for instance, in the case of the "March Moth," which was laying her eggs last season about March 30th); and where attack has been or is observable of other kinds than those already only too well known, I would gladly give all information in my power to all enquirers.

But, withal, it cannot be too carefully borne in mind that grease-banding is *not*, save accidentally, *of use, excepting to prevent* traffic of insects which must *walk or creep* to reach the branches, such as wingless moths, or beetles of kinds that are wingless or rarely use their wings, or caterpillars; although some amount of male winged moths are attracted by the presence of their wingless females, and strays of other kinds may be captured.

Two of the most important points to be considered in "Sticky Banding" trees are:—(1st) What material is best to use in order, if possible, not to hurt the trees, or (if it is of a hurtful nature) how best to prevent it soaking into the bark. (2ndly) What time or times of year the "smear" should be applied.

With regard to the material to be used, the following notes show that cart-grease answers the purpose of *catching the moths* thoroughly well, but also that (what is called) cart-grease may be so mixed with tarry or other matter deleterious to the health of the tree that it is requisite for all orchard growers to ascertain what the application sold them is made of; likewise that though it clearly catches the moths, it is likely to be very hurtful to the bark of the tree.

On December 1st, 1888, I was favoured by Mr. Charles D. Wise (Deputy Manager of the Fruit-grounds at Toddington, Winchcomb) with the following note regarding commencement of operations. This report shows the large scale of the operations, and their success in preventing the ascent of the moths, and likewise warns against the use of tar. Mr. Wise wrote:—“I think you will be interested to hear that we have caught millions of the wingless moth this season. As many as 500 have been counted caught in the band of grease on a single tree. As we have something like 100,000 trees, it has been a great business putting the bands on, and keeping them sticky. We have tried many different mixtures, but on the whole I have found cart-grease by itself, put on *thick*, answers best; it is cheapest, and,

I think, does no harm to the tree." "Where tar has been used, I have found the tree alive up to the place where the band was put on, but above the band dead." This observation as to the bad effects of tar is particularly valuable, and in another letter Capt. Corbett (Manager) further wrote on the same subject:—"Please note I have discarded tar, for I have found instances where, even when mixed with grease, it has, on drying, formed a tight band round the bark, and destroyed the tree."

There is of course no doubt that tar, or tar and soft-soap mixed, will stop progress of the moths travelling over the sticky surface; also it is very possible that on old trees (where the thickness of the bark protects the vital layer of young bark and wood forming beneath, almost as effectually as if a cradle of pieces of cork was fastened round the tree) there may be no damage caused by tarring; but this is very different to use on young trees, and I believe myself that tar should not be used on young bark, and in any case with care and caution.

With regard to cart-grease itself, so far as a regular form can be given, it appears to be usually compounded of tallow, palm-oil, and soft-soap, or, what comes to the same thing, tallow, palm oil and water, and caustic soda. Many recipes are given, but the following notes of the ingredients of some of the mixtures or preparations commonly made use of or sold under the names of "waggon," "axle," or "railway grease," may probably be of service in showing the ingredients of the ordinary compositions, and also that some of the additions or special makes suitable for special machine use are by no means what can be recommended for spreading at haphazard on living vegetable tissues.*

Of two kinds of railway- or waggon-grease mentioned, one consists essentially of a mixture of a more or less perfectly-formed soap, water, carbonate of soda, and neutral fat, whilst the other is a soap of lime and rosin-oil, with or without water. Frazer's axle-grease consists of rosin-oil of various numbers saponified with a solution of Sal-soda in water and softened lime. These two rosin recipes are apparently very similar to a composition used with success at Toddington, and of which the analysis by Prof. Bernard Dyer is given further on.

The following recipes are merely of greasy or soapy compositions; one is of tallow and palm-oil melted together and mixed with soda. Two others are of palm-oil and tallow for the foundation, mixed respectively with sperm-oil and caustic soda, or with Rape-seed-oil and soda; another, the "Austrian Railway Grease," is of tallow, olive-oil, and "old grease."

So far, there would be nothing deleterious to bark beyond what injury may occur from grease gradually soaking into the tissues.

The following recipes are given just as a sample or two of mixtures

* See pp. 376—379 of paper on "Lubricants" in 'Workshop Recipes,' by C. W. Warneford Lock, published by E. & F. N. Spon, Charing Cross, London.

that would presumably be highly *undesirable* to smear on unprotected bark, but which, still, if used with the proper protection between the bark and smear, might be useful, from being deterrent as well as adhesive. A preparation known as "Pitt's Axle Grease" is composed of black-oil or petroleum residue, animal grease, rosin (powdered), soda-lye, and salt dissolved in a little water. Hendrick's Lubricant is prepared from whale or fish-oil, white lead, and petroleum.

In another preparation, fish in proportion of about six parts in ten of composition is used--the fish (whole) being steamed, macerated, and the jelly pressed through fine sieves, for use with the tallow and other constituents of the mixture. Another consists of tallow, graphite (that is to say, black lead, which would not be needed for the use under consideration), and camphor in the proportion of 3 to 5 lbs. per cwt.

If this addition of camphor is practically possible, the smell would be so likely to prove serviceable as a deterrent that it would be at least worth experiment.

With regard to effect of two different kinds of smear, Mr. C. D. Wise wrote me from Toddington on Nov. 18th:--"I enclose copy of Mr. Dyer's analysis of grease. No. 1 is what we used last year, and which burnt the bark. No. 2 is what we now use on paper. I think I shall use No. 1 (if Capt. Corbett permits) again next year, as it does not run off the paper, which No. 2 does. As long as No. 1 does not soak through the paper, it cannot hurt."

The analysis of Prof. Bernard Dyer (Laboratory, Gt. Tower Street, London) was as follows:--"No. 1 Grease consists of tar-oils mixed with water and sulphate of lime. No. 2 consists mainly of rosin-oil, with apparently a little rosin, probably the residue from rosin-oil distillation mixed with a little carbonate of lime."--B. D. (see recipes and observations, p. 59).

I have also had report of Davidson's Composition being very serviceable, and as far back as 1881 I have had information of this composition being used on young Pines to keep off rabbits, as keeping the trees free of Pine Weevil-attack, but (without entering on names which might do disservice to dealers) I must add that in this I speak only of "Davidson's Composition" manufactured from the *original recipe*. There is a preparation said to be nearly the same, which may or may not be of service.

Amongst various sticky substances which are considered serviceable in the United States for banding with, melted india-rubber is noted as being serviceable on account of it "always retaining its soft viscid state." I do not find a recipe for its orchard-application, but, if not too costly,* some experiment might serviceably be tried on this matter. What we really want is some composition which is adhesive, but does not melt or gradually soak into the tree.

Stakes and tree-guards need attention.—Where young trees are fastened to stakes, tar is about the best application to stop traffic up these, and thence to the tree, which could be used; something of course must be done, either by removal or prevention of passage, and the ropes or ties of any kind by which the young trees are fastened will need attention relatively to possible infestation; where bundles of rough sticks are tied round the stems to prevent these being gnawed by animals, these guards will probably be a most fertile source of caterpillar-attack at hatching time in spring, unless well looked to, either by removal of the sticks or by re-smearing the stem of the tree above the part where they touch it.

How to guard the bark.—At present the simplest and cheapest plan that I have notes regarding the trial of is that which was largely used at Toddington last autumn. The material employed is the kind of tough paper which is made use of by grocers for wrapping up butter, lard, and the like, and is known as “grease-proof” paper. This is applied by a band as many inches wide as is thought fit (the wider the better) being passed round the stem of the tree. The band should be cut long enough for the ends to overlap well, and these are fastened by paste, and the whole is made secure by a piece of bast-mat or anything that will not cut the paper being tied round the paper near each end. This work can be rapidly and well done by women. On the paper bands the grease or application may be spread in any way preferred, but the best way is considered to be to lay it on with a thin, flat bit of wood, and plentifully, both as to width of band and thickness of layer. In this way, when I saw the managers in the autumn, 80,000 Plum-trees and about 40,000 more of other kinds were being treated at the Toddington Fruit Grounds.

The following note, which I was favoured with on Nov. 17th from Mr. Ernest R. Cheesman, of Bough Beech, Edenbridge, Kent, gives a slightly different method of banding, with note of success, and also of the small cost of the application:—“Now the course I have followed is this: I have first placed bands of impervious paper (such as is used by grocers for butter and other greasy substances) of about seven inches in width round the trees, a foot from the ground, first removing loose and rough bark so that the bands should lie quite close; on this I have placed a similar width of glazed calico lining, and tied tightly with strong string at an inch from both top and bottom of band, so that wind or rain cannot move it in the least; I have then used a mixture of cart-grease and soft-soap, mixed to the required consistency with train-oil, and laid on to the bands with ordinary paint-brushes; this was done by October 16th, and they have been served in the same way every week since, so as to keep them always sticky; and this I shall continue as long as the moths are being caught, and again in

the spring, when the buds are breaking, to make sure of late-comers. We have caught some thousands of both the males and females (which seem to keep together) of the *Cheimatobia*, a few of a much larger sort of moth, also wingless or nearly so (probably Mottled Umber.--Ed.), but these latter are not in any quantity here; I may add that in very few cases have any of the moths got as far up as the middle of the band, and I am fairly satisfied that we have caught all that had attempted to ascend. This mode is a little trouble and expense, but the latter does not exceed twopence per tree, even on full-grown trees, which most of mine are, many being very large ones, and this is a very trifling outlay, if a crop can be saved by this means."--E. R. C.

Various kinds of apparatus have been recommended, both in Germany and America, for stopping the moths,--some of wood, some of bands of tin applied in various ways,--but there are various objections to the use of these (at least so it appears to me), partly from the care that has to be taken to prevent harbourage of eggs, &c., beneath them, and partly from the greater expense; but if details are desired, I will give information and a working drawing of the most approved form to any applicant.*

The following notes refer more especially to dates for commencement of sticky banding in autumn, and show also from various reports of observation of the presence of the moths that were sent me, that this continues over a period of several weeks:--

On July 9th Capt. Corbett wrote to me from Toddington as follows:--"I send you the experience of one of our foremen with regard to the Winter Moth, and two other foremen who followed on the same lines have excellent crops of Plums. All trees greased before Oct. 17th were nearly free from caterpillar. Those not greased until after Oct. 17th were infested with caterpillar."

This point of greasing in good time is exceedingly important, and as the time of the moths coming out may vary with the different weather of each autumn, the following further observation sent me by Capt. Corbett of a simple method of knowing when to expect them may be very useful:--I would just add that another foreman kept some chrysalids of the Winter Moth in a box last autumn, and on the first moth coming out he put the band of grease round his trees. His trees are for the most part thickly laden with Plums."

Capt. Corbett also mentioned in another letter regarding this same point of greasing:--"One of our foremen states that where he applied the greasy bands to the trees early in October, the fruit suffered little

* Much useful information relatively to this class of attacks, and means of prevention, is given in the chapter on "Canker-worms," pp. 157--197 of the 3rd Report of the United States Entomological Commission, published by the Department of Agriculture, Washington, U.S.A., 1883.

or not at all, but where it was applied late in November, the fruit did suffer very much."

On October 18th I received some wingless grey moths (apparently the true Winter Moth) as specimens of a kind which existed in great numbers in a garden at Wimbledon, and which the writer was afraid would injure his Apple-trees.

On October 28th both male and female specimens of two kinds of moths were sent me by Mr. R. H. Gilroy as samples of the kinds which for two years had been infesting his orchards at Temple Laugharne, Worcester, and destroying the leaves and the fruit-crop. These consisted partly of the Mottled UMBER Moth (see fig., p. 57, by which it will be seen that this moth is easily recognisable); the others appeared to be the Winter Moth, the well-known *Cheimatobia brumata*, with large numbers of wingless females.

On October 31st, Mr. A. Burgum, writing from Matthews, Dymock, Gloucester, favoured me with the following very useful observation of dates of appearance of Mottled UMBER and Winter Moths. He mentioned:—"I commenced grease-banding early in October; the first capture was on the night of the 11th inst. (Oct.); variety, 'Mottled UMBER'; no Winter Moth captured until the 19th inst., but they are now becoming more numerous. I perceive they are to some extent depositing their eggs on the stems below the grease-bands."

On November 18th Mr. C. D. Wise reported from Toddington that, taking all their plantations through as last year, the Winter Moth was not nearly so numerous; this is some satisfaction as showing that care and outlay does act.

Mr. Ernest Cheesman, writing on November 19th from Bough Beech, Edenbridge, Kent, mentioned that the Winter Moths were still going up in large numbers, and in the orchard in pasture he had taken as many as thirty on one tree in a night; also that he did not see a single moth previous to October 24th.

On December 3rd, Mr. T. C. Hiatt, writing from Quinton House, Stratford-on-Avon, reported that he had banded his trees at Aston Subedge on three occasions, namely, Oct. 16th, Oct. 28th, and Nov. 14th, and thousands of moths, male and female, besides small caterpillars, were stuck fast to the bands round the trees--222 were found round one Plum-tree. In previous communications Mr. Hiatt told me he banded fifteen acres; the material used was in part Davidson's Composition, and in part this Composition mixed with Stockholm tar, to prevent it drying up too quickly, and he promised to inform me of results.

From the above notes it appears that presence of the wingless moths was observed at different dates from October 11th to November 19th, at which time the Winter Moths were still going up the trees in

large numbers. Also that trees banded in the early part of October fared much better as to absence of caterpillar-attack than those treated further on. How long after November 19th the ascent of the moths still continued we do not as yet know.

It does not appear worth while to take up space with mere record of date of *appearance* of the "Looper" caterpillars of the moths now under consideration, nor the amount of mischief done, as unfortunately all concerned know only too well the devastation caused by the ravages of the caterpillars amongst the tender leafage, and that this may be considered to begin as soon as the leaves are ready to be eaten. Just, however, to give one definite date--on the 1st of May young specimens of "Looper" caterpillars were sent me from Toddington by Mr. Charles D. Wise, with the observation that they had been hatching there for the last three weeks.

The point that we want to make out regarding these appearances is-- why is it that when we have sticky-banded the trees properly, and have done it in good time, and know that this is the case from the vast numbers of moths that we see we have caught, how after this does it happen that we have any Looper-attack at all? Also, what further measures can be taken to prevent this?

On May 27th Mr. W. A. Sutherland, Chief Reporter to the 'Worcester Herald' (72, High Street, Worcester), sent me the following letter relatively to passage of stray moths across the sticky bands, and passage of caterpillars in spring over the dried bands:--

Mr. Sutherland wrote:--"The blight question is again to the front in the county, and many fruit-growers are bemoaning their bad prospects arising from insect-plagues. . . . It is now suggested that a wider band of the grease-composition is necessary, and that it should be supplemented by lime-washing the trunks in spring. One grower tells me that he captured thousands of moths on the grease-bands last autumn. Some, however, were quite on the upper edge of the band, which may be taken as an indication that some others got over the grease altogether. On the other hand, other moths, after going a short way in the grease, turned back, and laid their eggs on the trunks of the trees below the band. Tiny caterpillars have been discovered on the trees over the grease, showing that they must have been hatched in the upper part of the tree; and again it is suggested that the fully-developed eggs in the dead bodies of the moths captured on the grease-paint may be hatched, notwithstanding their position."

The following letter from Capt. Corbett (writing from Toddington) shows that some moths certainly gained access to the tree above the band, as the eggs were noticeable there as well as below it, and also gives a plain working remedy, which, so far as it could be carried up the tree, might be expected to do a deal of good:--"We put bands of

grease in the autumn round our Plum-trees (we do not like *tar*), and killed thousands of moths; still a few eggs are to be seen on the branches, and a good many *below* the band of grease. We are dealing with them now in this way: we mix up a quantity of clay (as the basis), well tempered with soot, lime, cow-refuse, and water, and paint the whole of the stem of the trees with it, working it well into the cracks, and we hope that this will destroy the eggs."—R. J. C.

A slightly different recipe was also sent me by Capt. Corbett, which was used similarly to the above, that is, the trees were painted with it in March from the ground to the branches. This consisted of well-mixed clay, 4 parts; cart-grease, 1 part; and soot, 1 part.

Soft-soap, mineral oil, washes, or emulsions.—*Washing with a mixture of soft-soap with a little mineral oil is another means of cleaning the tree from stray eggs, which is recommended on excellent authority.*

On November 2nd, Mr. James Fletcher, "Dominion Entomologist," of Canada, in reply to a letter which I had suggested should be written to him by Capt. Corbett, asking his advice as one of the very best authorities regarding caterpillar prevention, favoured us with many useful suggestions, and regarding the point of destroying the eggs, he wrote as follows:—"For washing the trunk, to destroy all eggs which may have been laid during the winter, a kerosene emulsion may be used. This should be done in the end of March."—J. F.

The following recipes give directions for preparing the emulsion, and with us paraffin-oil may be substituted for kerosene-oil throughout:—

Kerosene and Soap Mixture.—"To make this I use one fourth of a pound of hard soap, preferably whale-oil soap, and one quart of water. This is heated till the soap is dissolved, when one pint of kerosene-oil is added, and the whole agitated till a permanent mixture or emulsion is formed. The agitation is easily secured by use of a force-pump pumping the liquid with force back into the vessel holding it. I then add water, so that there shall be kerosene in the proportion of one to fifteen."—Prof. A. J. Cook, in Bulletin 26 of the Agricultural College, Michigan, U.S.A.

I give the above recipe first, as, being noted as a satisfactory application for the Apple Aphis, it may be presumed the proportion of kerosene would not be enough to injure ordinary bark; but all experimenters should bear in mind that the strength and amount of mineral oil used must be well considered, and the same strength may not be safe on all parts of young trees.

Another recipe is for "Kerosene Emulsion" of the ordinary strength for general application, *viz.*, kerosene or refined coal-oil, 1 pint; common laundry soap, $\frac{1}{2}$ oz.; rain-water, $\frac{1}{2}$ pint. The soap was boiled in the water till all was dissolved, then the boiling soap-suds

were poured into a watering-pot containing the kerosene, and churned with a garden-syringe until the emulsion was complete. This generally takes about five minutes, but sometimes longer. When this emulsion is made, it can be bottled up for future use. When using it, either as a wash for sponging trees or for spraying, it must be diluted with nine times the quantity of water. Should the oil in the emulsion after a time separate, it is well to warm it, and by violently shaking the bottle it will again become fit for use. In diluting the emulsion use warm water. See p. 14 of 'Report of Entomologist and Botanist, Department of Agriculture, Canada,' 1887.

The following recipe is one of the Department of Agriculture of the United States of America. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of "Emulsion," as it is termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.

Soft-soap and paraffin-oil wash.—The following recipe, which was used by Mr. Ward, Superintendent of the Gardens at Stoke Edith, Herefordshire, in 1883, as a Hop-wash, is a much simpler form. As this was found to kill the Aphides without injuring the Hop-plant or the burr, it might be considered quite safe as a bark-application, and more of the ingredients might be added, as thought desirable. The proportions for large quantities are 12 lbs. of soft-soap and half-a-gallon of paraffin-oil to 100 gallons of hot water; the nearer to boiling the water is used the better the paraffin mixes. The mixture should be stirred well together, and used when cool.

The above applications may be used so as to destroy the eggs laid on the bands or below them, and, without doubt, would also be of use in preventing *ascent* of much insect vermin; but there are two plain reasons for possibility of some amount of "Loopers" being present in spring on the trees, notwithstanding careful autumnal banding. One of these is that some of the Winter Moths may develop in spring instead of autumn, and consequently, though few in comparison to the autumn numbers, they need watch to be kept by an examination of

trees in the evening or after sunset, or by banding a few experimentally, and, if necessary, grease-banding again. This operation would also prevent ascent of the so-called March Moth (for fuller account of which see reference in Index). The other point of very great practical importance, on which I think much Looper Caterpillar presence even on the best protected trees may turn, is the transportation of the wingless females, in the act of pairing, by the winged males. That this takes place does not seem to me to be open to doubt. The belief of the orchard-workers in one badly-infested district (very likely in more) that, as it is expressed, the males carry the females to the tops of the trees on their backs, points to this being a common occurrence, and I have myself observed the winged male and the wingless female moth lying drowned, still in connection, in a water-tub in my garden, where presumably they had fallen in flight round the Apple-trees close by.

The only prevention for this appears to be the use of lamps and tarred boards (see p. 77), but the advice to *prune as late in the winter as can well be managed, and to burn all the prunings*, would do some good as a remedy, because the Winter Moth is considered to lay her eggs by preference towards the ends of the shoots, and where it is possible to have these cut off and burnt, much infestation would be got rid of.

I had a very good note on this subject, on February 6th, 1889, from Mr. C. Lee Campbell, of Glewstone Court, Ross. In this, after some observations on attempted measures for checking infestation, he remarked:—"May I suggest that there is a more effectual remedy, consisting in cutting off the ends of the branches on which the eggs have been deposited, and burning them. I have found that an enormous proportion of the eggs are deposited at the end of every branch pruned in the autumn, as much as fifty eggs being found on one branch. At a moderate calculation, my men have thus destroyed some 6,000,000 eggs on 5000 to 6000 Pyramid Fruit-trees within the past months, in addition to a very large number caught through greasing the stems."—C. L. C.

So far as prevention of "Looper" Caterpillars goes, it does not seem possible in the present method of fruit-farming to suggest any treatment better than the above (or at least on the same principles) for keeping the trees clear of eggs, or destroying these eggs before hatching.

Various other measures may be suggested, especially such as stirring or dressing the surface of the ground, but these appear to be very difficult to carry out practically, and, as we stand at present, banding in some way or other seems to be the only *preventive* measure we can trust to for stopping ascent of wingless pests, and also one

without which (though it is not a perfect plan) the trees would be likely to be ruined.

But withal it is a matter for very serious consideration of fruit-growers what course it will be necessary to adopt to keep down orchard infestation. With orchard-insects, as well as with other kinds of crop-insects, it may be almost surely laid down that where the same crop is constantly grown, the insect-feeders on that crop may be expected to be there also in great numbers, and at present the matter of prevention of infestation is on a very costly and unsatisfactory footing.

There are (say) three or four kinds of wingless moths giving rise to various kinds of Looper Caterpillar-attacks, two or more kinds of web-nest-making caterpillars, and various others, as the Figure of 8 Moth, &c., and, excepting the Winter and the Mottled Umber Moth, these mostly come out at different times of the year, or (in some way) each differs from the others so far in its habits, that different measures of prevention are needed, or the same measures have to be applied at different times of year.

But (however different in history) for the most part these caterpillars are *alike in destroying leafage* in the early part of the summer, one might say May and somewhat before, and after, and what is wanted is a sort of "wholesale" treatment which will act on all alike.

Jarring, that is, shaking the boughs so smartly that the caterpillars fell down, answered well in such cases as I had report of last season.

Prof. T. Elliott, of the Weald of Kent College of Agriculture, wrote me that in this way five bushels of small green caterpillars could be collected in a day on a large fruit-farm.

Capt. Corbett wrote from Toddington:—"The only useful way seems to be to shake the caterpillars into a sheet; in this way one man collected two gallons."

The difficulty in this plan is from the chance of some of the dislodged vermin creeping away and going up the stem of the tree, or returning up their threads to the boughs. These points are met fairly well in the following method advised by the Entomological Commission of the United States of America, 1880-82:—" *Jarring and burning*.—The worms should not be allowed to reach the leaves, but, where this has been allowed, it is best to strew the ground lightly with straw on a calm day, give the tree a good jarring, which will suspend all the worms in mid-air, cut loose the suspended worms by swinging a pole above them, which breaks their silken threads and causes them to fall to the ground, and then set fire to the straw. A Canker-worm holocaust will be the result, and if this is done on a calm, clear day with a little care, the tree need not be injured."* The caterpillars may be prevented

* 'Report of Entomological Commission, U.S.A., Department of Agriculture,' 1880-82, p. 191.

going back up the trunk of the tree by a hay-band or rough rag-rope with some tar on it being placed on the ground round it, or a circle of tar might be dripped on the ground or short grass.

Fumigation.—In the course of the observations at Toddington, where everything was noticed, accidental or otherwise, which might throw any light on means of getting rid of the almost overwhelming quantity of orchard-vermin, it was noticed that in several cases where they chanced to be exposed to the action of smoke, or fumes, as from burning clay, or rubbish-fires, &c., that these acted serviceably in lessening or clearing attack.

In one instance a road was being formed amongst the trees, and by the side of this clay was burnt for some time; it was observed that near where this was carried on there was little or no attack, and the amount of it gradually increased with the increasing distance of the trees from the smoke or altered air of the clay-fires.

In another case rubbish-fires had been lighted near enough to some infested trees for the caterpillars to be within the range of annoyance or stifling from the smoke, and they fell down in such great numbers that I understood from the managers that the trees were to all practical purposes cleared.

In yet another case the smoke of burnt wood which had been dipped in tar and rose beneath the trees was reported to Mr. Wise to have good effects. Consequently on these accidental observations, all the rubbish, &c., suitable for making "smoke-fires" is being saved to burn in the spring, so as to give the fumigating a good trial, and the effect of addition of tar and of sulphur to the fires is also to be tried.

It is needless to say that in these experiments smoke or fumes only are to be used, and, from previous personal experience of "smother-fires" under the trees in a Fir-plantation of about thirty years old in Gloucestershire, I do not see any reason why the fumigation should not be managed without harm to the trees. At any rate the experiment is well worth trying, and if pieces of disused railway-sleepers were put to heat in the choke-fires, the powerful stench would be likely to add much to the effect.

Spraying with Paris-green. — On application being made by Capt. Corbett to Mr. Fletcher, the Dominion Entomologist of Canada, for advice (as before mentioned), amongst other points of his reply Mr. Fletcher mentioned:—"In this country we have a moth with similar habits to your 'Winter Moth,' and decidedly the most successful treatment has been spraying the trees early in spring, when the young caterpillars are just hatched, and again two weeks later on with a weak solution of Paris-green."

Again, in another part of the same letter, Mr. Fletcher observed:—

“With regard to the Winter Moths which have been so injurious in England this year, I am under the impression that the most satisfactory mode of treatment will be to spray or dust the trees with some of the preparations of arsenic. For my own part I prefer ‘Paris-green,’ as being of more uniform strength than ‘London-purple’ and other compounds. The chief point to be guarded against is getting the liquid too strong.”

These suggestions, coming from such an eminently well-qualified adviser, careful and experienced, as well as practically acquainted both with the subject itself, and also the extent to which the plan has been adopted both in Canada and the United States, are well worth consideration. “Paris-green” is chemically an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing; and should not be applied to fruit, or to vegetables that are used for food, but, as will be seen in the following recipes, the quantity advised for orchard-use in the Canadian Government Report (quoted below) to check Looper-attack on leafage is very small.

For liquid application, the amount recommended for spraying for Codlin Moth or young “Looper” Caterpillar is not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water (4 gallons, E. A. O.), to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves.”

“For general use on mature foliage.— $\frac{1}{2}$ lb. of Paris-green, 50 gallons of water.” First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom.”*

So far back as 1873,† Paris-green spray or wash was noticed as serviceable for destroying this class of caterpillars (as well as others), and I might almost say that the leading official entomologists of Canada and the States have thought me to blame in not bringing forward *here* what has been proved *there* to be of great service by trial of many years, and over an area of thousands of miles. Therefore I beg now to draw attention to the use of Paris-green as being an insecticide well worth careful trial; and as the different names under which this chemical is sold, and likewise its exact nature, are not generally known in this country, I give the following information, with which I was favoured on application to Messrs. Blundell & Spence, of Hull, as

* ‘Report of Entomologist and Botanist, Central Experimental Farm, Department of Agriculture, Canada, 1887, p. 21.

† ‘Report of the Entomological Commission,’ published by U.S.A. Department of Agriculture, 1880—82, p. 192.

being well-known manufacturers and great exporters of Paris-green to the United States of America and Canada.

In reply to my enquiries, Mr. J. Dixon (Manager) wrote me on December 31st, 1839 :—“ Emerald-green, Paris-green, Schweinfurth-green, are different names for the same thing. The first name is English, and is the one used in most of our Colonies, India, and China. The second is the American term. The third only used in Germany, and by German traders.

“ Emerald- or Paris-green is a double salt of arsenite and acetate of copper—in other words, an aceto-arsenite of copper. You may take the U.S.A. analysis of Paris-green as correct. Provided Paris-green be pure, the analysis of different makes should be all alike, as it is a true chemical compound.

“ The pure article (which is that used as an insecticide) is a true crystal, and varies in colour from a deep to a pale green, according to the size of the crystals. Both sorts are used, and we should think the pale, small crystal the best for this purpose.

“ The dark shade is almost universally preferred, and commands a higher price. The reason probably is that this colour is of itself a guarantee of the purity of the article, as the reduced or adulterated qualities are all either pale or of a very bad colour.

“ As the pure pale is of a finer form, it would go further in use, and, when mixed with water, would keep up better.”—J. Dixon, Manager to Messrs. Blundell & Spence, Hull.

With the information Mr. Dixon forwarded me samples of the dark and paler shade of Paris- or emerald-green, and also of the pale shade reduced about five per cent., with the observation that, if paler than this last, it should certainly be rejected. It is difficult to give an idea of tint by description, but perhaps to say that the desirable colours were a slightly darker and lighter shade of the colour called Apple-green would come fairly near.

In reply to some further enquiries on my part, Mr. Dixon favoured me with some special details. In his first communication he had furnished me with the precise chemical formula of composition of Paris- or emerald green, but subsequently replaced this (as being a more desirable form of statement for the present purpose) with the following percentage analysis of pure emerald-green :—

“ Percentage Composition of Emerald-green :—

	Per cent.
“ Copper . . .	32·11
Arsenic . . .	28·56
Oxygen . . .	32·48
Hydrogen . . .	0·76
Carbon . . .	6·09
Total . .	<u>100·00</u> ”

With regard to depth of tint, Mr. Dixon added that :—“ Colour alone is not an all-sufficient test. To a small extent the dark shade may be reduced with aniline green, and, in the matter of judging colour, all are not equally proficient. Though not met with in trade, an emerald-green can be made very much paler than the palest sample we sent you, and still be pure. We send you a sample of the palest pure we have ever made; for your purpose this might be the best.”—J. D.

WITH REGARD TO METHODS OF DISTRIBUTION. — So far as I am aware, the best method of distributing the fluid application in the fine even spray which is desirable would be by means of the Strawsonizer set to have a vertical action, or by throwing it from some of the washing-engines so high that it might fall again in a gentle spray. For more complete work, such insecticide appliances as those known as the Riley or Cyclone nozzle used in America, or the modifications of them which could be fully as well made by our own as by continental firms, would in the end be probably by far the best.

The subject was first brought forward by Prof. Riley (now Entomologist of the Department of Agriculture of the United States of America), at the National Congress of the United States in 1872, as a likely means of destroying the “Cotton-worm” (the caterpillar of a moth which causes great injury to the Cotton-crops), and the results of trial fully realized his expectations*; but the great success which brought Paris-green before the American agricultural public, and gave it a place as a serviceable insecticide, which it has held ever since, was its effect, when other special measures failed, in destroying the hordes of the Colorado Potato-beetle, “which were invading and threatening the entire ruin of every Potato-field throughout the Northern and Middle United States east of the Rocky Mountains, and southward into North Carolina, and Northern Texas. . . . Paris-green is a combination of arsenic and copper. . . . In its pure state it contains fifty-eight per cent. of arsenic (arsenious acid).” †

In Dr. Lintner’s paper, quoted above, some of the results are also given of the series of experiments undertaken officially by Dr. William M’Murtrie as Chemist of the United States Department of Agriculture, in order to ascertain the effects of Paris-green on soil and the plants grown therein. Of these the following are of importance with regard to some of the ordinary objections made to the use of Paris-green :—

Dr. Lintner notes :—“ The results obtained were these :—

“ 1. An aggregate of 906.4 pounds of Paris-green per acre must be applied before any injurious effects on plant-growth ‡ are appreciable.

* ‘Eighth Annual Report of the Noxious Insects of the State of Missouri,’ by C. V. Riley, State Entomologist.

† ‘First Annual Report of Injurious, &c., Insects of the State of New York,’ by Dr. J. A. Lintner, State Entomologist, 1882, p. 26.

‡ This, it will be noticed, refers to growth, not to effect when applied on leafage.

(The ordinary application to a Potato-field is from a pound to two pounds per acre.)

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

“3. Potatoes subjected to applications of Paris-green failed to give evidence of the presence of arsenic”; and after giving notes of many kinds of insects to which this insecticide may be applied with especial benefit, and detailed observations of its success in clearing spring Looper Caterpillar, Dr. Lintner concludes his exhaustive paper on Paris-green, its nature, use, and method of application, with these words:—

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

The above observations are not offered as in any way giving a full account of the application of Paris-green, but simply as notes of what it has been found may be done in the case of Looper Caterpillar to check this destructive attack. For full accounts of everything that can be thought of with regard to all methods of application to most kinds of crop, the reader is referred especially to the publications of the U.S.A. Department of Agriculture, some of which have been quoted; also Reports of the Official Entomologists of different States, especially Dr. Lintner’s Report, quoted above; and also the official notices, likewise quoted, of the Entomologist to the Dominion of Canada.

At first here, as elsewhere, some difficulties in application are likely to occur; if too strong, or the mixture not evenly distributed, the leafage *will be*, if too weak, the caterpillar *will not be*, hurt; but the great point in first experiment is to be sure that the mixture is *not too strong*. If too weak, this mistake is easily corrected, and it would be best to try a pailful at first on a tree or two than to risk more. Also it is advised that it should be used in dry weather, or necessarily the application may be washed away; and likewise it is to be remembered that Paris-green is insoluble; it does not dissolve in water, but mixes with it, so unless the mixture is kept stirred, or by some means or other in movement, the powder will settle down at the bottom of the water.

* “Paris-green as an Insecticide,” pp. 25—34 of Dr. Lintner’s ‘First Annual Report as State Entomologist of New York State, U.S.A.,’ quoted above.

With regard to any risk to the owners or workers, the points requiring care, consequently on its poisonous nature, are that the bags of "green" should be kept locked up, lest children should be attracted to them by their beautiful colour (this colour is a complete safeguard against the powder being used by accident for household purposes), and also that those who mix the powder should use common care not to inhale it through mouth or nostrils.

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders. I particularly wish to draw attention to Mr. Dixon's observations on this head, given in his replies to my enquiries (see *ante*, p. 71).

"In handling this article in the dry powder, care is required, as a light green dust arises which is breathed in, and produces unpleasant results; and in one instance a customer who thought he could save money by buying it from us in bulk, putting it up himself in paper parcels, employed a man to weigh out and wrap about 5 cwt. in 1 lb. parcels. *This cost the man his life*; so as we are laid out for this business, sometimes wrapping 10 tons in a week, we can really do it at much less cost.

"We have never heard of any accidents to users in America, and there is no danger when using it in water" (*i. e.*, from its flying about, E. A. O.), "but you might advise any who wish to try dusting it on dry to carefully stand to windward."—E. Dixon (Director), Messrs. Blundell & Spence, Hull.

Where the Paris-green is used as a dry powder dusted on the plants, these points require consideration, but in mixing half to a quarter of a pound with water this may be done without the slightest risk; where I have had myself to weigh or move small quantities, I have found that folding a piece of thin muslin over the mouth and nostrils made all perfectly safe.

With regard to price.—I made enquiry on this subject from Messrs. Blundell & Spence, who replied that for my general guidance they should say that a retail trader would not probably sell the pure article in small quantities under 1s. 3d. per lb. They being wholesale manufacturers do not furnish in very small amounts, but quantities of 1 cwt. and over would be furnished at 10d. per lb.; and, for cash *with* order, any quantity not less than 14 lbs. would be sent separately wrapped in 1 lb. paper parcels, and carriage paid. I give the above details, as whenever the subject of Paris-green has been a little brought forward, there has been almost invariably much delay and difficulty, from details or locality of where it was purchasable not being generally known.

My only knowledge of thorough use of the Paris-green wash in England was in 1884, when I recommended its trial to check a severe

attack of Willow-beetle near Lymm, in Cheshire, and the result was reported to me by Mr. H. Cameron and Mr. G. H. Leigh (also of Lymm) as highly successful.*

Yet one more point remains to be mentioned, and this regards the possibility of catching caterpillars on their way down the trees in the summer.

On May 20th Mr. Hiatt forwarded me a parcel of branches for examination, which I found to be infested with multitudes of Looper Caterpillars, and on the following day he informed me that he had set ten men to work in an orchard of his at Aston Subedge, and had put tarred hay-bands round about six rows of his trees, which had been nearly destroyed by blight; and he reported that large numbers of caterpillars had been destroyed by sticking on the hay-bands, and that he had painted above them a band of the remainder of a barrel of Davidson's Composition.

On May 27th Mr. Hiatt further mentioned that he had again been to the trees to see results of work, and "found that thousands would be little to say concerning the quantities stuck (on Davidson's Composition), besides the numbers on the tarred hay-bands."

The above point is well worth further experiment. As the caterpillars were caught on Davidson's Composition, which was painted on the trees *above* the tarred hay-bands, it would appear that they were caught in the act of descending the trees, consequently were cut off either in the act of migration to other trees, or on their way down to turn to chrysalids in the ground; but in any case further observations on this matter would be useful.

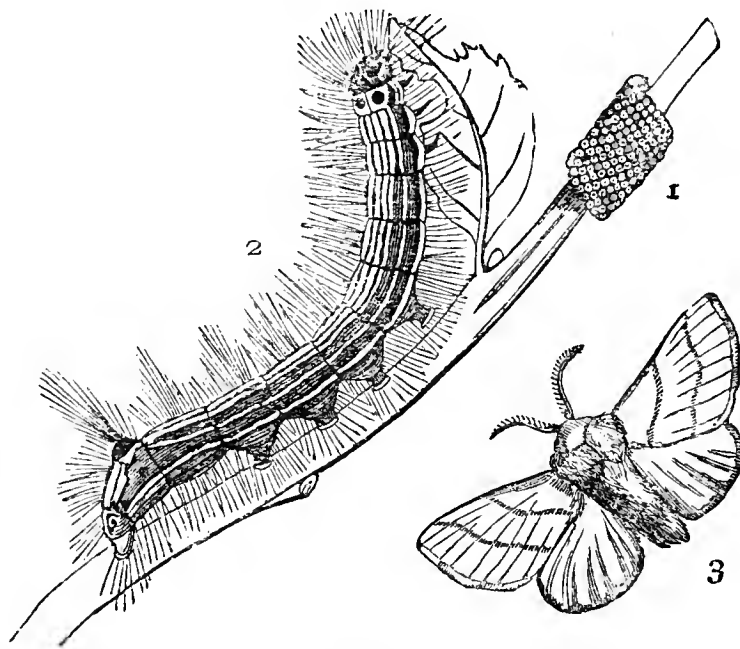
Descriptions of the common kinds of Orchard Moths and caterpillars, together with the main points of their habits, have been so often given in previous Reports that it is quite unnecessary to repeat them at length; but to save trouble in reference, or for service of those who may not have the preceding Reports at hand, I add a few lines of description of the colour of the common kinds to the figures, and then append some observations of a few kinds not previously noticed in these Reports.

Winter Moth; Evesham Moth, *Cheimatobia brumata*, figured at p. 56.—Winged male greyish brown, with transverse markings on the fore wings; hind wings pale, with very little marking. Female greyish, with darker marks on the abortive wings. Caterpillar forms a loop in walking; colour very variable—the commonest tint green, with darker line along the back, and white lines along the side; head green or yellowish; legs green, but when first hatched they are greyish, and they may be found, when nearly full-grown, of almost all shades from palish green down to almost black.

* For details of attack, and method of application, and description of can and apparatus used, see my 8th 'Report of Injurious Insects,' pp. 95—99.

Mottled Umber Moth, *Hybernia defoliaria*, figured at p. 57.—Winged male usually pale brown, with darker brown cross-bands on the fore wings; hinder wings pale, with a brown spot near the middle, but sometimes the wings are of a uniform freckled brown. Female almost totally wingless; body brown, with two or more dark spots on the back of each segment. The caterpillar is brown above, with a black waved line along each side, and beneath this it is bright yellow, underneath of a more greenish yellow. It is also somewhat marked above with grey, and, like the Winter Moth Caterpillar, is a "Looper."

Other kinds of Looper Caterpillars are more or less present each season, but not, as far as I am aware, usually to a really serious extent. The caterpillars of the "March Moth," however, resemble those of the Winter Moth so much—from being "Loopers," and of a greenish colour, with one or more whitish lines along the sides—that as such they were forwarded to me during the past season. I have added a short note regarding them further on.



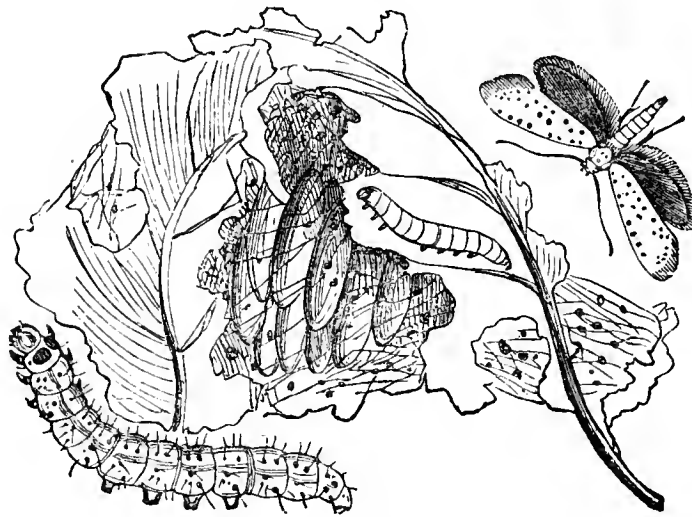
CLISIOCAMPA NEUSTRIA.

Lackey Moth and cluster of eggs, nat. size; and caterpillar, magnified.

The two kinds of web-nest or tent-making caterpillar, of which the injuries are most commonly observed on orchard or garden fruit-trees, and more especially on Apple-trees, are the caterpillars of the Lackey Moth figured above, and those of the Small Ermine, or Small Apple Ermine Moth.

The Lackey Moth (figured above at 3) has the fore wings of some shade of rusty fox, yellowish, or dark brown tint, with two transverse bars, which are sometimes paler, sometimes darker than the colour of the wing; the hind wings are of some tint of brownish. The caterpillars, when full-grown, are about from an inch to an inch and a half in length, hairy, partly of a bluish grey colour, and gaily striped with white along the back, and three orange or red stripes and one blue

stripe along each side; these stripes are divided by black lines, or black spotted with blue, and there are black spots on and near the head. They go into chrysalids in cocoons, which they spin almost in any convenient slight shelter near their food-trees.



YPONOMEUTA MALIVORELLA.

Small Ermine Apple Moth, and cocoons in web; caterpillar much magnified.

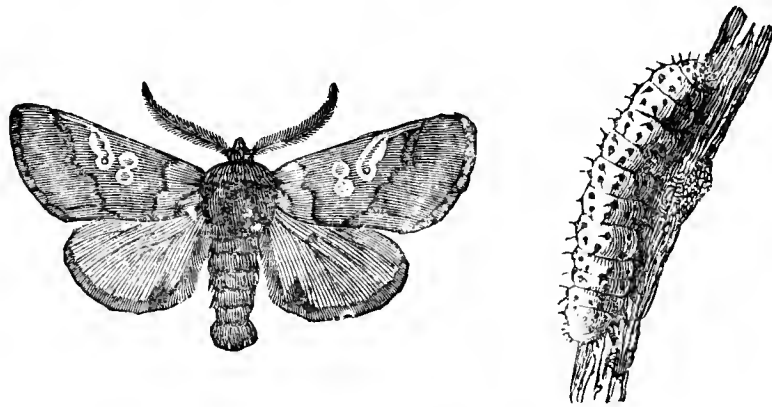
The "Small Ermine" or "Small Ermine Apple" Moths (as it does not appear perfectly certain whether there are two kinds, of which one more especially infests the Apple) are very little moths, only about three-quarters of an inch in full expanse of their wings. The fore wings are usually livid, or whitish dotted with black, and the hinder wings lead-colour; but they are very variable in appearance, and the Small Ermine Apple Moths are distinguishable by their fore wings having the black spots on a pure white ground. The Small Ermine Moth caterpillars are of a dirty ash or ashy white colour, spotted with black; when full-grown, the ground-colour is dirty yellow or lead-colour. They spin their cocoons in the web-nest which sheltered them in feeding-time, and those of the Apple Ermine are said to be white and opaque.

Both of the above attacks may be to some degree remedied by cutting off the web-nests or rough tents of the caterpillars when they are within, and destroying them; or something may be done by crushing the caterpillars in the webs with a strongly-gloved hand, where the infested branches are in reach. For other preventive treatment see previous Reports.

The Figure of 8 Moth is about an inch and a quarter in the spread of the wings. The fore wings brownish or grey-brown, marked, as shown (p. 78), with black lines and white spots, one pair of which, formed of two small white kidney-formed figures in the middle of each wing, form the marking like the number "8," which gives its name to the moth. The hinder wings are brownish, with darker rays and dark patch at the hinder angle, as figured.

The caterpillar is about two inches long, green or smoky green

above, yellow-green below; one yellow stripe (interrupted at distances) runs along the back, and one yellow stripe along each side; the body of the caterpillar is spotted with black, and so are the claw-feet; the four pairs of sucker-feet beneath the body have two black spots on each. The caterpillar takes its name from the head having often a bluish tint. It goes into cocoon spun up with bits of bark, or anything apparently that may be conveniently at hand, and attached to twigs, or stems, or neighbouring walls, or similar positions.



DILOBA CÆRULEOCEPHALA.

Figure of 8 Moth, and ("blue-head") caterpillar.

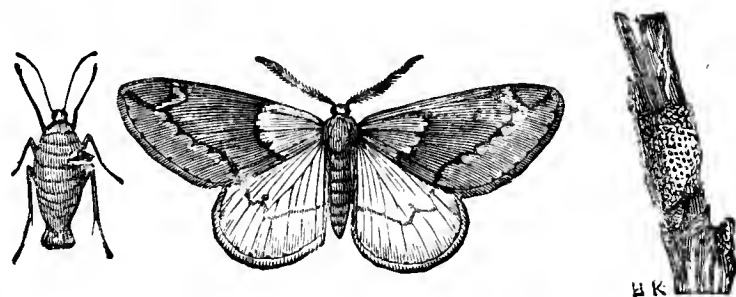
The moth may be found from September onwards in the latter part of the year; and on November 18th Mr. C. D. Wise reported to me from Toddington:—"We have found and are now catching, by means of the lamps, the Figure of 8 Moth."

As I was aware that Mr. T. W. Beach, of the firm of Messrs. Beach & Sons, of the Steam Fruit Preserving Works, Brentford, took much personal interest in arrangement of lamps adapted for attracting and capturing night-flying moths, I enquired of him whether it was his plan that was used as above, and received from him the following note:—"Replying to your letter respecting the lamps used at Toddington, I must inform you the arrangement they had previously to my idea was by placing a lighted lamp under an open shed, the underneath part of the roof or boards being tarred and greased."

The plan suggested by Mr. Beach, consequently on observation of the numbers of male Winter Moths which had been seen flying round the public lamps in the neighbourhood of Evesham, was that a trap could be arranged in the form of a shade fixed over the light, and the lower surface of the projecting shade coated with a greasy composition similar to that which is placed round the stems of the trees, and, by the moths flying upwards to the light, it was likely that their wings would become attached to the grease, and they would be captured. Whether on general principles it would be desirable to have lights about at night where they might be tampered with by vagrants or mischievous people, seems to me open to doubt; but as we certainly want to get rid of the moth-pests, and the plan of lights and smearing together was found to act for this purpose, I just allude to it.

The following observations refer to the "March Moth," of which the Looper Caterpillars appear about the same time with, and are not very unlike those of, the Winter Moth:—

March Moth. *Anisopteryx æscularia* Steph.



ANISOPTERYX ÆSCULARIA.

March Moth; winged male, wingless female, and band of eggs.

On March 29th Mr. W. Stedman forwarded me from the Dunsdale Fruit Farm, Westerham, Kent, specimens of the wingless females of the March Moth, together with bands of their down-embedded eggs, which they were then laying on Plum-twigs. The moths were about three-eighths of an inch long, brown or fawn-colour above, shading to grey below, with darker head and eyes, and dark pencil of hair at the end of the tail, and might be generally described as thickly pear-shaped (the pencil of hairs at the end of the tail answering to a broad, short fruit-stalk). The hairs were long, the six legs very long, and the moths, though sometimes quite quiet, were able at pleasure to walk very rapidly; one that I timed as to speed walked the length of six inches in twenty-five seconds. The wings were to all appearance totally absent, and the downy coating of the moths very smooth and silky.

Mr. W. Stedman remarked that in the previous season he had found several Plum-trees suffering from the attacks of insects, and whilst pruning on that day, namely, March 29th, he had found the wingless moths, which he forwarded to me, in the act of laying the eggs which were attached to the Plum-twigs sent.

The twigs were quite small (none of them as much as a quarter of an inch across), and the bands of eggs which were then laid (or being laid) varied from about a quarter to half an inch in breadth at the widest part, but did not always quite encircle the stem. They were deposited with beautiful regularity, and showed to the naked eye as if laid in almost precisely parallel rows along the twig, and were embedded in down supplied by the parent moth from the pencil at the end of her tail. In the largest band I counted twenty-nine rows, and as each of these rows (as nearly as I could count or estimate) was composed of upwards of eighteen of the bright, shining eggs, the whole number in this ring would be well over five hundred.

The "Looper" Caterpillars which hatch from these eggs are of a light or whitish or clouded green, with a white or lighter line along the side, and another above the feet, the lowest (according to descriptions) being the most noticeable. These caterpillars feed on many kinds of trees, but are noted by German observers as being particularly injurious to Plum-trees. When full-fed, they turn to chrysalids "in or on the ground," and, according to Dr. Taschenberg, in a loose web. The moths appear in March or April. The male moth is winged, and of the size and pattern figured at p. 79; the upper wings marked with various transverse bands or lines of brown or paler tints; the hinder wings paler, with a zigzag line.

For prevention of attack of this moth, it might be hoped that, as the chrysalids lie "in or on" the ground, thorough disturbance of the surface during winter would do good. In this way they would be turned out of their self-arranged shelters to alternate cold and wet, which is an excellent method of lessening amount of insect vermin.

Another means of prevention, in the case of trees where the end twigs are *in sight* and *in reach*, is looking, towards the end of March or in April, to see whether the ends of these twigs are infested by the bands of wool-embedded eggs, and, if so, having these cut off and destroyed.

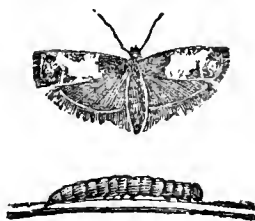
On large orchard-trees many of the twigs would be too high to see, or to reach conveniently, but in very many cases the use of a light, long-handled pair of very small-bladed shears or nippers would get over all difficulties; a small hawk's-bill pair of nippers with light handles about six feet long (such as I have myself been in the habit of using) would reach to a fair height, and do the work well and neatly. Two or three feet more at least might be gained, without going to the expense of any special apparatus, by having a bit of board laid across the top of a little hand-cart, which the operator could himself move without difficulty round the trees. This would furnish him with a stage or platform from which he could easily reach to about thirteen feet or more from the ground. The prunings of course should be all burnt.

The dressings of various kinds mentioned at p. 65 as being used in March or April to kill Winter Moth eggs on the stems of the trees, or regular greasing (in case it was known from the preceding year's experience that attack of this special kind might be expected), would be likely to be useful in preventing ascent of the wingless moth.

For remedial treatment, when the caterpillars are present, the measures of jarring, fumigating, spraying, &c., previously mentioned, would be likely to be as serviceable with these as with other Loopers; and it is worth notice that in the case of the very nearly allied orchard-pest of N. America, the Spring "Canker-worm," or, as we should call it here, the Spring Looper Caterpillar of the *Anisopteryx vernata*, that spraying with Paris-green proved a valuable remedy.

This subject is strongly drawn attention to by Dr. Lintner in his first 'Annual Report' (p. 33), and the following special observation of its use is quoted in a note on the same page:—"The following active measures against this pest were employed in the extensive orchard of Mr. Chapin in East Bloomfield, Ontario County, New York, of one hundred and twenty acres:—The Canker-worm commenced its inroads, and was worst last year on the interior trees. Mr. Chapin showered them with a mixture of Paris-green and water, which brought them dead to the ground in a few hours. The water was drawn in a box holding over two hundred gallons, in which was mixed $2\frac{1}{2}$ lbs. of Paris-green. *A forcing-pump and hose threw a stream high above each tree, where it broke into a spray, and falling sprinkled every part.*"

The Eye-spotted Bud Moth; Red Bud Caterpillar, *Hedya ocellana*, Fab.; *Tmetocera ocellana*, Schiff. Also Pith Moth, *Laverna atra*, Haw.



TMETOCERA OCELLANA.

Eye-spotted Bud Moth, and caterpillar.*

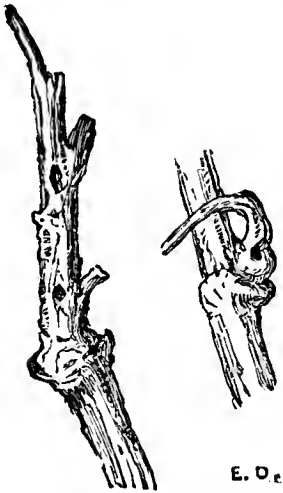
The Bud and Pith Moths have not been previously reported to me, but either kind is able to cause a good deal of injury, and when, as in the case noted below, both kinds are present together, the attack is very injurious.

Early in the summer of 1889, Mr. Oliver E. Janson, F.E.S. (of 22, Perth Road, London, N.), mentioned to me that harm was being caused to Apple-trees in his immediate neighbourhood by attack of caterpillars, and of these the first that developed to moths proved to be of the "Red Bud Caterpillars," now known as the *Tmetocera ocellana*; but later on, the other kind, that is, the Pith Moths, also appeared, and in this case I have the advantage of identification of the double attack from such a well-skilled entomologist as Mr. Janson. I give his description of the injury observed, and afterwards a short history of the two species of moths. Mr. Janson favoured me in September with the following observations:—

"Early in May my attention was called to the unhealthy appearance of many Apple-trees in orchards and gardens in the neighbourhood of Hornsey, and as I afterwards noticed that some dwarf Apple-trees in a

* The above very pretty figure is copied, with thanks, from that given in 'Insects Injurious to Fruit,' by Prof. W. Saunders, Director-General of the Experimental Farm Station, Canada.

garden handy for observation were similarly affected, I examined these more closely, and found that the young leaves remained stunted and shrivelled, instead of fully expanding, and towards the middle of the month all the young shoots, many of them just showing blossom, began to droop and wither. As these particular trees had yielded fair crops of fruit in previous years, and no apparent reason could be assigned for their sickly aspect, I examined some of the withered shoots, and, upon cutting them open, found a small larva was present—either under the bark, just at the juncture of the young growth with the old wood, or in the centre of the shoot, close to the bud, where a small hole with a little frass protruding was generally observable on the outside. By the end of the month every young shoot had drooped and shrivelled, the trees to all appearance being dead; upon then cutting open some of the shoots, the larvæ were found to have changed to chrysalids in the burrows. A quantity of the dead shoots were cut off and placed in glass jars with fine gauze coverings, and on June 8th the first imago appeared, and proved to be the *Hedya ocellana*; the moths continued to emerge in great numbers up to the 20th of the month, and varied in the colour of the fore wings from the usual broad white banded form to dull grey and nearly black, with very indistinct markings.



Apple twigs from which *Laverna atra* were reared.

“A few days later, and on till nearly the middle of July, a considerable number of specimens of another moth, the *Laverna atra* (one of the Tineina), also emerged from the same shoots, but as at the time of observation I did not suspect that there was more than one species engaged in the attack, no means were taken to ascertain whether the habits of the two pests were similar. After cutting off and destroying all the dead shoots, the trees soon showed signs of returning vitality by throwing fresh buds, and the foliage later on appeared fairly healthy; but as no fresh blossom was produced, the result of the attack was an entire loss of fruit.”

The caterpillars of the Bud Moth, the “Red Bud Caterpillars,” as, from their reddish tint, they are called in Germany, are mischievous both in Germany and North America to various kinds of orchard and other trees.

The moth is especially distinguishable by the broad white band somewhat spotted with grey, which, it will be seen, extends across the (grey) fore wings from one side to the other. The moths are stated to come out from the end of May until July, and to lay their eggs on the buds, where they remain all the winter. The caterpillars are brown, with black heads, and black plate on the back of the next segment, “slender and active.”

When the sap begins to flow in spring, the caterpillars hatch, and they are described by Kaltenbach as attacking the leaf-buds, by Schmidberger as especially eating the end bud of young grafts. Their presence may sometimes be known by a drop of sap flowing from the leaf-bud.

The caterpillars also attack the expanding flower-buds, and it is noticed that "they are to be found concealed in the depth of the spun-together, withering, and drying-up leaves and bunches of flowers; later on they attack the neighbouring healthy leaves and fruit, and gnaw down to the epidermis of the under side of the green leaves, or even the leaf-stalk." It is stated to turn to the chrysalis state amongst the rubbish and dirt caused by its presence.

For prevention of further mischief, Schmidberger recommends opening the buds which are seen to be glued together by a drop of sap with a penknife, and extracting the caterpillar; but the more summary process of breaking off the bud and destroying it, caterpillar and all, would seem more desirable, or, later on, picking off the killed, partly developed, and infested buds.

Pith Moth, *Laverna atra*, Haw.; *L. Hellerella*, Dup.—The *Laverna atra*, or Pith Moth, is a little moth only half an inch across in the spread of its wings, with white head and face; the fore wings black, with the inner margin white to beyond the middle, with an irregular white band proceeding from it to the tip of the wing, and other white markings; but sometimes the wings are stated to be almost black, and the head and face darker; the hind wings grey.

The moths are mentioned by Mr. Stainton as "not scarce in June among Whitethorn; the dark variety appears exclusively attached to the Apple; it is possible it may be a distinct species." For description and locality quoted see Stainton's 'Lepidoptera,' Tineina, pp. 239 and 240.

The only published observations on the habits of the species that I am acquainted with are those of Herr Muhlig, of Frankfort-on-Maine. He observes that "the caterpillars which live through the winter wait the return of spring close together ('dicht') in a boring under the bark of an old twig, beneath an Apple-bud. In May the little caterpillars bore into the growing young shoot, and feed on the pith; they also advance into the flower-stalk, and eat it hollow, whence the Apple-blossom fades, or even the whole flowering-stem withers off miserably, and is ruined. The larvæ are often found there in overwhelming numbers, so that it is easy to see what injurious enemies the *Laverna Hellerella* (of Duponchel) are to Apple-trees."

"The caterpillars live in the same way on the allied Whitethorn, which they more especially infest in this neighbourhood (Aix la Chapelle), but to these bushes the damage is less important."*

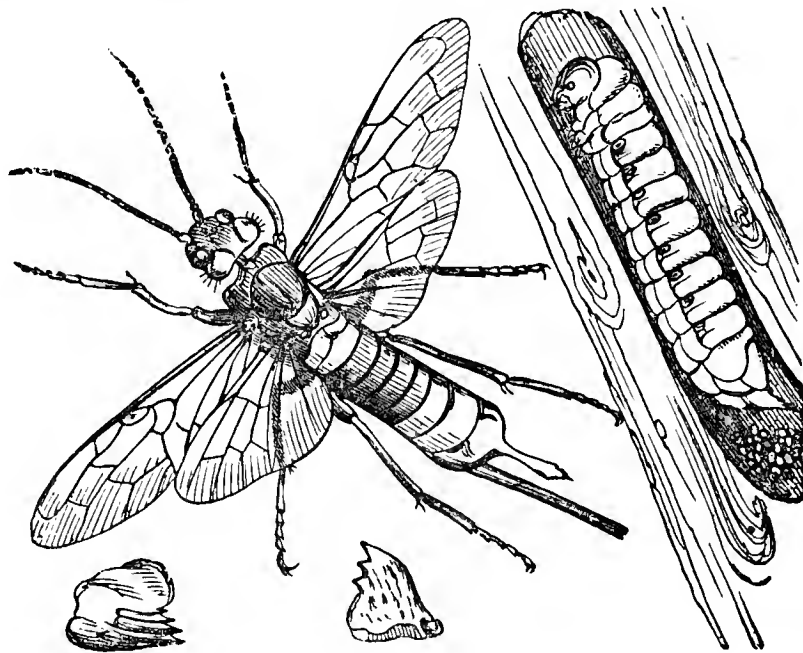
* 'Die Pflanzenfeinde aus der Klasse der Insekten,' von J. H. Kaltenbach, p. 781.

From the above observations it would appear that almost the only preventive measure in the case of this kind of attack is to cut off the young growing shoots or flower-stalks when they show signs of infestation, and burn them with the contained caterpillars; and a little attention to this point, and also to clearing buds or opening blossoms infested by the Red Bud Caterpillar, would certainly be useful. If either of these attacks are much observed, I should be glad of observations of them.

NOTE. -- Observations of other injurious orchard insects were forwarded during 1889, but as the most important of these have previously been noticed, and this paper has run to great length, I have not entered again on these attacks.

PINE.

Giant Sirex; Yellow Fir-wood Wasp, *Sirex gigas*, L.
Common Steel-blue Sirex, *Sirex juvencus*, L.*



SIREX GIGAS.

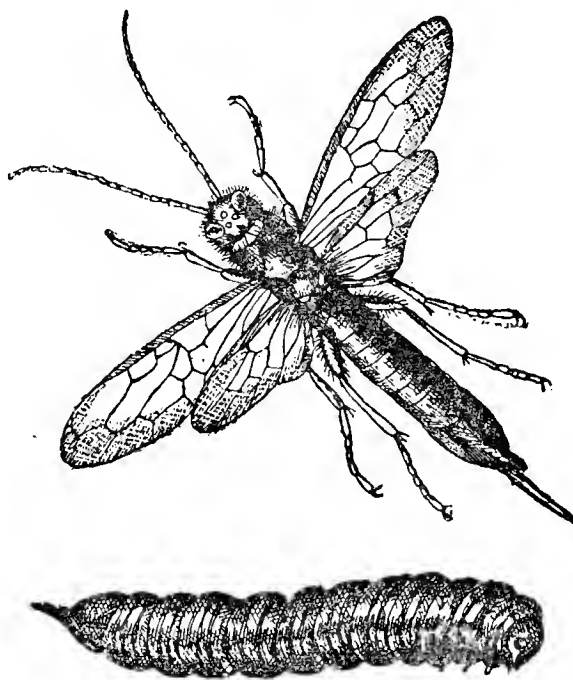
Female "Wood Wasp" and maggot. Jaw of maggot, with four sharp, narrow teeth; and jaw of fly, with three broader teeth, both magnified.

From the great size and brightly-contrasting colour of its yellow and black markings, the Giant Sirex is a very conspicuous insect, and a few specimens of this or of the Common Steel-blue Sirex* are from

* I have adopted the German name of "Steel-blue Sirex" for this species, as, excepting in case of special variation, the deep glancing blue of the female distinguishes it fully from the yellow and black colour of the commonest kind of British Sirex, namely, the yellow and black *S. gigas*. There is another blue Sirex, the *S. magus*, recorded as being sometimes, but very rarely, found in England (in the neighbourhood of London); the female of this is distinguishable by having various white dots and stripes on the blue abdomen. It therefore appears that if we add the word "Common" to the received German name of "Steel-blue," that this name will be quite correct, and also a great help towards recognising the female of this very remarkable insect. Further details are given on p. 85.

time to time sent me in the warm season of the year. In the last season, however, some more special observations were forwarded to me of their powers of destructiveness to Fir-timber, suggesting that it would be well for their attacks to be more attended to.

The female of the Giant Sirex is from an inch and a third to over two inches in the spread of the wings; head black, with some yellow markings; and the body between the wings and the abdomen, excepting the first two and the last three rings (which are mostly yellow), black also. The abdomen (as figured above) ends in a long point, beneath which is, in its horny sheath, the strong ovipositor with which the insect bores through the fir-bark to deposit its eggs. The male is smaller, with the abdomen yellowish, excepting the first and last segments, which are black.



SIREX JUVENCUS.

Common Steel-blue Sirex and maggot.

The *Sirex juvencus* is a most variable insect, both in its size and colouring. The female is commonly blue-black, with brownish or rusty-colour in the legs; the male blue-black, with the margin of the third and the whole of the four following segments red; the hinder shanks and feet dilated and compressed.

The size varies from about half an inch to an inch and a third or an inch and a half in length, and from about three-quarters of an inch to a little above two inches in the spread of the wings. This variation appears to me to be much influenced by the conditions of the maggots having been favourable or otherwise, for amongst specimens sent me during 1889 some fine females, measuring quite the fullest length given above, were sent me from an old Silver Fir, where everything must have been suitable for growth, whilst amongst specimens from some buried wood used for supporting drain-pipes I had a male just under

half an inch long, and a female five-eighths of an inch long, including the ovipositor.

The habits of these two kinds of *Sirex* appear to be almost exactly similar. The females pierce into the bark of the Larch, Silver Fir, or other kind of Conifer that they may attack (standing or felled, as the case may be), and with their strong ovipositors deposit their eggs, one at a time, in the soft wood immediately beneath.

The maggots are whitish, soft, and cylindrical, with scaly heads furnished with strong jaws. The three pairs of feet are very small, and at the rounded tail-extremity (above) there is a blunt point or spine; they feed in the solid timber, causing great injury by their large borings. The maggot of the Giant *Sirex* is from one and a half to two inches long when full-grown, and is considered to be full-grown in about seven weeks.

The chrysalis is like the perfect insect in form, but white and soft, with the limbs laid along beneath the breast and body until complete development. After a time the perfect insect comes out of the tree or log, or it may be the plank or piece of furniture, in the wood of which it has fed, but the time which may elapse between the maggot being fully grown and the *Sirex* making its appearance seems to be quite uncertain.

The following notes by Mr. W. Hodgson, A.L.S., of Workington, Cumberland, show the great amount of damage which can be caused by *Sirex*-attack—in this case that of the Common Steel-blue *Sirex*:—

Mr. Hodgson mentioned that whilst walking through the grounds of Mrs. Robertson Walker, of Gilgarron, about five miles inland from Whitehaven, he was struck by the failed condition of the fine Silver Fir trees, and, on asking the reason:—“The woodman stated that the injury was due to the ravages of a grub which perforated the trunks of the trees so extensively, especially in the upper part, as to cause the mischief. This was only found out recently, when some of the dead trees were felled and taken to the saw-mill on the estate. We examined some of the fallen trees, and their condition supported entirely the woodman’s view of the case.”

“The grub which was found at work proved to be that of a *Sirex*, and later on, specimens of the perfect insect being found, were sent to Mr. S. L. Mosley, of the Beaumont Park Museum, Huddersfield, by whom they were identified as being the *Sirex juvencus* (the “Common” or “Steel-blue” *Sirex*.—ED.). The number of Silver Firs on the grounds is slightly in excess of forty trees, of over seventy years’ growth, varying in bulk from twenty to forty cubic feet per tree. This will give on the whole a trifle over 1200 cubic feet of timber irretrievably damaged, which, estimated at sixpence per foot, represents a loss of £30 in money value, to say nothing of the injury done to the appear-

ance of the woods and coppices, of which they formed a striking ornament.

“ Three-fourths of the Silver Firs may be counted as already dead; the residue are in a moribund state. Three of the trees in the most southerly belt of plantation standing in a line equidistant from each other all leafless and dead. . . . Nothing short of cutting down the whole of the trees and burning the wood would seem to obviate the danger of the ravages of this destructive pest extending to other species of the Pine family in the grounds. In a block of the damaged wood measuring 14 in. in length by 8 in. in diameter which was forwarded to Mr. Mosley, he counted thirty-three perforations from which perfect insects had made their escape.”—W. H.

The extraordinary power of the jaws of this species (the *S. juvencus*) is recorded by Dr. E. L. Taschenberg in the case of a female in his possession, which had made its way through a piece of lead-covering at Freiburg;* but I never met with a similar case myself until last summer, when I was favoured with the following observation by Mr. Montagu H. C. Palmer, of the Manor House, Newbury. This was sent with specimens of the *S. juvencus* accompanying, and is very interesting, as in this instance we have the full record of the Sirex-tunnel leading up to the perforation in the lead pipe, and also of the presence of the insect.

Mr. Palmer wrote me that this Sirex occurred at a village near Newbury, where some water-pipes had been laid, and he enclosed specimens from the wood which was close to these leaden pipes, adding:—“ The most interesting part is, the leaden pipes have been pierced in several places quite an eighth of an inch thick, and have caused much damage.”

On September 18th Mr. Palmer further noted that some specimens of the Sirex had been caught on the wing; and in reply to my enquiries he mentioned:—“ I am quite certain it was caused by the Sirex. . . . I have the piece of pipe with the hole in it; not only this, but the fly was in the hole, the pipe resting on the wood, the hole along which the insect has come corresponding to the one in the pipe. Not only this, but there were three or four holes in the pipe exactly the same.”—M. H. C. P.

The specimens sent me were of various sizes, and some noted at p. 86 were stunted so completely down to the smallest recorded size of this variable species that it pointed to the buried wood having been very ill-adapted to their healthy development.

About the middle of September specimens of some very fine females of this same species (the Common Steel-blue Sirex) were sent me by Mr. R. H. Eden, of Hillhampton House, Stourport. He mentions:—

* ‘Praktische Insekten Kunde,’ P. II., p. 368.

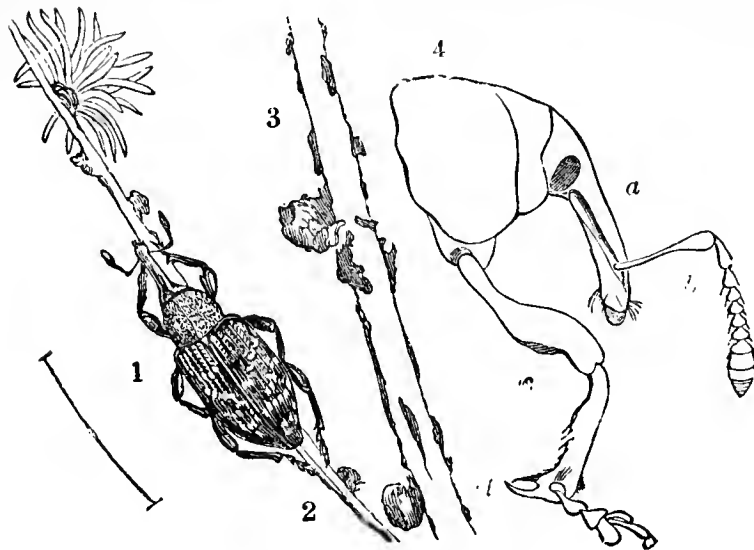
“In reply to your enquiries, I found the *Sirex juvenicus* I sent you while I was staying with Mr. Nelson, of Friar's Carse, about eight miles from Dumfries. We noticed that a Silver Fir of some eighty years' growth was dying. Mr. Nelson had it cut down. All the upper part of the main trunk and all the branches were riddled with holes; in those cases the insect had escaped, but I cut several out, most of which would have got away in another day or two. Several trees of the same sort had failed, and been cut down in the last two or three years, but, as far as I could gather from the men employed, they were infested by an insect marked like a Wasp, probably the *Sirex gigas*, and they had not noticed this sort before. I think one or two Silver Firs only are left, and they *look* sickly.”

With regard to prevention of Sirex-attack to old Silver Fir trees, it is possible that something might be done to protect favourite or specimen trees by finding whether from age or other circumstances the outer bark was flaking off in the way described in Selby's 'British Forest Trees,' p. 472, leaving a newly-exposed cuticle.

Where the thin under-bark is thus exposed, it would presumably be particularly inviting to Sirex-attack, and for a few favourite trees it would be worth while to try the effect of a good smearing with soft-soap preparation, or any deterrent which would be likely to protect the tree (where the bark had scaled off) during the time when the "Timber Wasps" are about in summer, and would gradually wash off without harming the surface to which it was applied.

For general purposes, the only reasonably practical way of preventing spread of Sirex-infestation appears to be timely removal of infested timber, whether in the form of standing or felled trees, or fallen trees, or infested limbs. The wood need not be wasted; what is of no use as timber should be split at once into small pieces for fire-wood (logs for burning), and, if found to be infested, it would be better to use this at once before the maggots have time to develop. Some could almost certainly be saved for service as timber, but the trees should not lie with the bark on, which attracts more attack.

Felled trunks, and sickly or old trees in which the sap is not in vigorous flow, appear to be specially chosen for attack. I have myself known the *Sirex gigas* appear in such numbers from a Fir-stem lying in a timber-yard close to a Fir plantation that from twelve to twenty were caught in a few hours; but this is the only instance I have known of such great numbers developing at one time, that catching them as they appeared would be an easy remedy.

Pine Weevil. *Hylobius abietis*.

HYLOBIUS ABIETIS.

Pine Weevil, rather larger than life; line shows nat. length, with snout extended; Larch-twigs injured by Weevils; head, with snout, horn, and fore leg, much mag.

During last year I had a few notes of observation of the Pine Weevil. These beetles are sometimes excessively injurious in plantations of young Conifers, as Scotch Fir, Larch, Spruce, &c., where they do harm by feeding on the bark of the young shoots, or eating off the bark of the young trees, sometimes completely baring lengths of the young stems.

The means of preventing the presence of these weevils, or of getting rid of them if established (mainly by not allowing the accumulations of waste wood, as loppings, trimmings, &c., often left in Fir-plantations, after thinning, in which rubbish the weevil-maggots especially feed), has been very fully entered on before. But in a note kindly sent me by Prof. Allen Harker, of the Royal Agricultural College, Cirencester, the Pine Weevil-attack mentioned is so completely traceable to (so to say) the "nursery" for it being kept up in the plantation, that this example of the *success* with which it may be reared by letting the maggot-food remain undisturbed is of very serviceable interest.

The Pine Weevils are hard pitchy-black or brown beetles about half-an-inch long, with the wing-cases rounded down at the side so as to give them a somewhat boat-like shape. The head is prolonged in front into a snout or proboscis, near the end of which are placed the elbowed horns; the body behind the head much pitted, and the wing-cases with alternate rows along them of punctures and tubercles, or wrinkles, and also marked across with yellowish bands and spots, as figured above.

The beetles lay their eggs (in this country chiefly in June or July) in rifts in the bark, and especially choose such places as pieces of fallen or felled timber, logs with the bark on, or the pieces of wood with the

bark, which have been thrown aside in plantations where thinnings have been rough-dressed on the spot. Also they much frequent root-stocks, or portions of exposed roots of felled trees which have been cut off at ground-level.

Here the maggots hatch and feed, as there is moisture enough to suit them, but not a healthy flow of sap to choke them in their tunnels. When full-grown they are about half-an-inch long, whitish and fleshy, with brown heads; they are much wrinkled across, and the three segments next the head much enlarged; they are footless, or have only just indications of the presence of feet on the three front segments. They may be found in the above-named feeding-grounds from about July onwards either in maggot or chrysalis state until the spring of the following year, and amongst methods of prevention one of the best is so to clear away all rubbish that there is nothing for the beetles to lay in; or, on the other hand,—following the German method,—to let the pieces of logs, waste pieces of outsides, and the like, remain about as decoys or traps for a while, and in the course of the winter gather all together and burn them, with the contained maggots.

Regarding the *establishment* of attack by systematically leaving loppings on the ground, Prof. Harker wrote me that in July last he received through one of his students an enquiry as to the nature of an insect's attack on new plantations of Coniferæ in Nottinghamshire, and after some correspondence a supply of specimens sent showed the presence of the Pine Weevil, *Hylobius abietis*, in such great numbers (both in chrysalis and beetle state) as to leave little doubt that these were "the prime offenders." In reply to Prof. Harker's enquiries, the owner of the estate kindly furnished full particulars, which he forwarded on to me as follows:—

"The new plantations on the property are some thirty acres in extent, and were planted twenty years ago. They consist chiefly of Coniferæ, Spruce, Scotch Fir, Larch, Austrian and Corsican Pine, while round the mansion there is a Pinetum comprising numerous species of *Pinus picea*, *abies*, *cupressus*, &c. The trees which have succumbed to the attacks of the beetles are chiefly Scotch Fir, some of them well-grown trees of from twenty to thirty feet in height, but one or two *Pinus laricis* and a few *Pinus austriaca* died from the same cause. Some Spruce and a few Piceas also perished, but it was not certain in their case that they were attacked by the beetle.

"It is ten or twelve years since the beetles first appeared, and the trees killed by them had been burnt. Pure paraffin has been used to smear the trees near the house.

"I recommended treatment on the lines suggested in your 'Manual of Injurious Insects,' laying especial stress on the necessity of removing all fallen timber, prunings, and loose bark throughout the whole of the

plantations. This elicited the very interesting information that whenever the plantations have been thinned, or boughs cut off, *they have been allowed to lie on the ground, with the idea of not robbing the soil.* This reprehensible practice had, however, been discontinued two years ago.

“You have often pointed out in your various Reports that the burning of all such dead wood, while not robbing the land, but rather more quickly, through the scattered ashes, enriching it, would, on the other hand, have deprived the beetles of comfortable lodgings and ample board in which to thrive and multiply, and become the pests they have proved. The setting of traps has since been efficacious, and the rubbing of the trees with a wash of red-lead and paraffin is said to have had good results.

“No better instance could be given than the history of this *Hylobius*-attack and its attendant losses, and their subsequent arrest and amelioration, of the importance of the knowledge of the habits of any injurious insect, and the clue which such knowledge alone gives to useful and sound methods of prevention.”*—A. H.

On May 15th a large number of beetles were forwarded to me by Mr. A. L. Y. Morley from Great Brington, Northampton, with the observation that Lord Spencer's forester had just brought them as specimens of insects which were doing considerable damage to young Larch, Scotch Fir, and Corsican Pine, in plantations near to Northampton.

On examination I found the Pine Weevil, *Hylobius abietis*, was present, but also there were a quantity of little brownish short-nosed weevils with no wings, and marked with a little black stripe running from the base (half-way along the suture) of the wing-cases.

These turned out to be the *Strophosomus coryli*, F., a small weevil only about one-fifth of an inch long, which is noted by various German writers as having attacked some kinds of Conifers, as well as the Hazel (*Corylus*, from which it takes its special name), and many other kinds of deciduous trees. I have never met with the attack before, but as it may need future notice, I add at foot a translation of its life-history given by Dr. E. L. Taschenberg.†

* Those who wish to study the history of the Pine Weevil, with means of prevention and remedy, will find it detailed in ‘Praktische Insekten Kunde’ of Dr. E. L. Taschenberg, Pt. II., pp. 129—136; and also in my own ‘Manual of Injurious Insects,’ pp. 233—240, in which much information is given, expressly contributed by Scottish foresters.

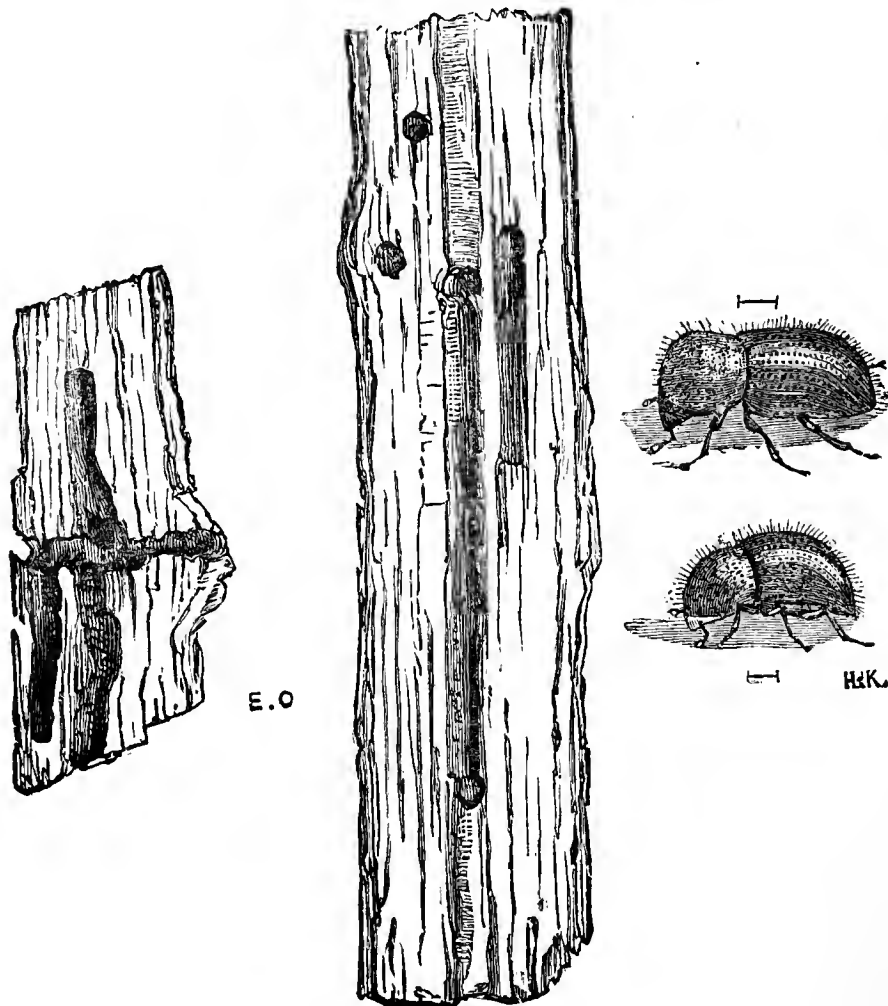
† “This beetle appears in many years in great numbers, not only on ‘Hazels,’ as might be inferred from its scientific name, but also on Birch, Oak, Beech, Scotch Fir, and Pine, where from May until the middle of June they feed on the buds and leaves, and the bark of the young shoots, and in various localities have destroyed young trees of the above-mentioned kinds. In the middle of June pairing takes place on the plants. The larvæ live in the earth, any injury caused by them is, however, still unknown.”—‘Praktische Insekten Kunde,’ by Dr. E. L. Taschenberg, Pt. II., p. 103.

The methods of prevention advised consist of shaking down the little beetles, and destroying them; or digging holes, and filling these with pieces of boughs or twigs from their food-plants, such as will attract the beetle, which, it is advised, should be cleared out and killed every morning.

Looking, however, to the circumstance of the beetles being wingless, it would perhaps answer better to smear round the base of the stems with any composition known to be safe for the tree, and thus catch them on their upward road. Probably this is a case in which spraying with emerald-green, or Paris-green, which is the same thing, would, as with the Willows at Lymm (see p. 75), do much good.

PLUM.

“Shot-borer.” “Apple-bark Beetle.” “Pear-blight,” *Xyleborus dispar*, Fab.; *Bostrichus dispar*, Fab.; *Xyleborus pyri*, Peck (of American writers).



XYLEBORUS DISPAR.

Male and female beetle, magnified; lines showing nat. length. Plum-stems, showing horizontal and perpendicular galleries.

The following observations refer to the serious, and often rapidly fatal, injury caused to young Plum-trees by the *Xyleborus dispar*, or “Shot-borer,” a very small dark brown beetle, which had previously

been considered to be one of our rarest species, although on the Continent it has been recorded as occasionally doing enormous mischief to various kinds both of young orchard and forest trees.

The injury is caused by the beetles driving their tunnels, so as in the case of quite young trees to partially ring them, and also to clear out an inch or so of the central pith; in the older, though still far from full-grown trees, the borings were not so regularly placed, but still, from their large number, they interfered with the passage of the sap and did great harm.

The first information I had of this beetle was sent me early in September from Toddington, where it had then been newly observed; but later on, that is, early in December, I had information (with specimens accompanying) of this same beetle having been present for three years, and doing serious damage in a locality near Kidderminster; also that it had done much harm at Hartlebury (a village about four miles from Kidderminster), and also that it was present at another farm in a different direction, about seven or eight miles from Kidderminster.

From these notes it is to be feared that the beetle has established itself far too widely for it to be stamped out easily, but (where known of), from the peculiar nature of the attack, it might very likely be *prevented*; and it is worth notice that in Germany it has often been found to disappear as suddenly and unaccountably as it made its first appearance.

The first observation of its presence was sent me from the Toddington Fruit-grounds on September 1st by Mr. Charles D. Wise, who reported as follows:—"I enclose a portion of the stem of a young Plum-tree, in which you will see a small beetle, which has bored its way into the wood, and killed the tree. We are losing several trees from the same cause."

On examination I found that the cause of the injury was the "Shot-borer" Beetle (as it is called in America). These beetles are of a pitchy-brown or pitchy-black colour; the wing-cases are of a redder brown in the male than the female. The fore part of the body behind the head is granulated; the wing-cases have alternate rows of fine punctures, with flat spaces still more finely punctured, and somewhat hairy. The horns are clubbed at the ends, and, as well as the legs, of some shade of yellow or reddish tint.

The great peculiarity of these insects is the difference in shape and size between the male and female (the *disparity*), from which the beetle takes its name of *dispar*). The female is about the eighth of an inch long, narrow and cylindrical, with the thorax (the fore body) large in proportion, and raised in the middle so as to make a kind of hump. The male is only about two-thirds of the length of the female,

and much wider in proportion, and the back is flatter. The wings which I examined in the female were well-developed, and thickly sprinkled with very short, bulbous-rooted bristles.

Another peculiarity has been considered to be the extreme rarity of males compared to the number of females, and amongst from about fifty to sixty of these Shot-borers which I took out of their borings in Plum-stems in September, I found only one male. Subsequent search, however, made me think that in winter the difference in proportion of numbers would be found to be not nearly so great, for amongst some specimens I examined early in December I found a larger proportion of males; and about a month later, amongst specimens I took (on or about January 10th) from a piece of Plum-stem two inches and a quarter across, about seventeen males to six females.

The borings at this winter time of year only contained a sprinkling of beetles, instead of, as in September, being so crowded up that there was scarcely room to insert another beetle into the row that filled each boring.

The reason of the singularly rapid and complete destruction of the stem of the young trees attacked by these beetles is plainly shown on laying open their tunnels. In the specimens from Toddington which I examined (figured life-size at p. 92), I found that the injury began by a small hole like a shot-hole being bored in the side of the attacked stem, from which a tunnel ran to the pith, and a branch about the eighth of an inch across ran horizontally about half or two-thirds round the stem. Sometimes this tunnel was about midway between the outside and the centre, but in one instance quite at the outside of the wood. From these horizontal borings other borings were taken straight up and down the stem; these might be certainly as many as four (perhaps more in one stem), and were from half an inch to upwards of an inch and a half long, and of these tunnels (in the pieces of stem I examined), one ran along the pith, which was completely cleared away. The great injury caused by these galleries fully accounted for the death of the stem.

At the time of examination, that is, on or about September 12th, the tunnels were filled with beetles; where the width only was enough for one, the beetles were arranged in a row one after another in procession, as it were; where the tunnel was a little wider (as where the pith had been cleared away), they were less regularly arranged, but crowded in, so that there scarcely seemed to be room for another. In one length of wood of about two inches I found, as near as might be, thirty beetles. The work of destruction was still evidently going on, for in some instances I found that, instead of being as usual black and discoloured, the sides of the tunnel or the extremity were white and moist, showing the beetles were still feeding. The instinct of tunnelling

was so strong at the time, that a quantity of beetles which I secured in a tube, buried themselves so rapidly in the cork, that between the 10th of September and the morning of the 12th they had already bored five tunnels into it, and it contained at least seven female beetles.

In the tunnelled wood I found one white larva, but could not say anything certain as to its species. Amongst specimens sent by my request to Mr. Mosley, Beaumont Park, Huddersfield, he wrote me on Sept. 18th that one stem was about a foot long, with four holes to the outside, and on cutting it up he extracted a hundred and eleven females and five males of *X. dispar*. Mr. Mosley also forwarded to me three white larvæ which he found dead, "all together at the bottom of one of the perpendicular galleries. These were about one-sixteenth of an inch in length, fleshy and white. The one I especially examined was very markedly ringed, of about an even girth throughout the body, but smaller at the head, which was furnished with a strong pair of yellowish jaws, browner at the tips. The tail extremity was blunt, and the body sprinkled with a few hairs; the segment next the head was furnished with a tubercular-like prolongation appearing to answer to a foot, but I could not say whether it was the *X. dispar* maggot or not."

The method of attack is stated by Schmidberger to be for the beetles to choose a spot, usually on the main stem of the tree, making no distinction as to the tree being sickly or healthy, young or old, so long as it is thick enough for the purpose,—at least half an inch in diameter. (The attacked stems sent me from Toddington were from a little under to a little over three quarters of an inch across.—ED.). The female then proceeds to bore passages, and in a small chamber at the opening of each of these she is stated to lay her snow-white, longish eggs. The first-hatched larvæ are recorded by Schmidberger as being noticeable about the end of May, and these are considered by him to arrange themselves (in the same manner as the beetles we noticed as above described), one after the other in the tunnels so as to fill them, and to feed there on a whitish substance with which the passage is encrusted, and there the maggots, according to the observations quoted, turned to chrysalids and thence to beetles.*

This general history of the beetle agrees in all the points in which we have had the opportunity of comparing it with the habits of our English *X. dispar*.

It is held by some German writers that each of the maggots bores a gallery of its own, but Schmidberger, who studied the matter

* *Bostrichus dispar*, Schmidberger (*Apale dispar*, Fab.); *Xyloterus dispar*, Erichson. See 'Naturgeschichte der Schädlichen Insecten von Vincent Kollar,' pp. 261—273, and English translation 'Kollar's Treatise on Insects,' pp. 254—262.

minutely, on about a hundred pieces of stem from his infested apple-trees, one of which he split almost day by day (to watch gradual progress of development), especially notes that he does *not* think such is the case.

It appears also to me to be impossible that it should be so in the case of our Shot-borers, because if each larva started a tunnel of its own, we should in that case, instead of only about, say four to six tunnels all of the full width of a beetle, find as we do in other cases with many wood-boring beetles *a great number of side-tunnels*, possibly short and of one width throughout, possibly increasing in width to accommodate the growth of the maggot.

I have not found any signs of side-borings in any of the pieces of wood which I have split, or in which I have carefully dissected out the various tunnels; in all these there have only been the borings previously described, and in the report on this beetle given in 1887, by Mr. J. Fletcher, Dominion Entomologist, Canada,* I do not find any mention of side tunnels formed by the maggots.

The point we need to make out, as it might help us very much to get rid of the attack, is,—*What do the maggots feed on?* In some of the tunnels of Plum-wood sent me from near Kidderminster, I found a white material, which proved on skilled examination kindly made for me, to be partly of mycelium of a fungus, and partly apparently of an animal nature; but there was so little then present that we had not enough to test thoroughly, and also, as beetles only were then present, it would not have been a certain guide as to what the maggots fed on; but in the coming season this is one of the points which needs investigation, and I should be very glad of specimens to make sure precisely from what the maggot-food may be.

The amount of harm that is caused by the attack is shown in the following communication, which I received from Mr. Samuel Wright, of Greenhill Farm, near Kidderminster.

The first was sent me on the 10th of December, as follows:—

* See paper on "Shot-borer," "Pin-borer" (*Xyleborus dispar*, Fab.; *Xyleborus pyri*, Peck.), of American authors, pp. 26—28 of Report of the 'Entomologist,' Central Experimental Farm, Department of Agriculture, Canada, 1887. From this I also quote the following extract, which is of much interest in shewing that the difference of appearance of the male and female beetle caused them for a time to be considered as distinct species. Mr. Fletcher writes:—"Mr. J. B. Smith, of Washington, who kindly confirmed the identification of the specimens, writes to me, 'The *Xyleborus* is *pyri*, i. e., the female is; the male is *obesa*. This proves what Mr. Schwarz has long claimed, that *obesa* was but the male of *pyri*. Both of these are equal to the European *dispar*, Fab. *Obesa* is extremely rare, only two or three specimens being known so far.'" Mr. Fletcher was kind enough also to send me specimens of the male and female *X. pyri*, to give me the opportunity of comparing them with the same species which we know now as *X. dispar*.

“ I have forwarded to you a piece of tree which is infested, in the hope that you might point out to me some method of destroying these dreadful pests, as I have suffered very much by them the last three years. I find that where they once attack a tree it is doomed. It is chiefly the Victoria plums that they get at. I am not having any pears or apples attacked as yet.”

The piece of Plum-stem sent was two and a quarter inches across, and on splitting it open I found it was infested by the *Xyleborus dispar*, but the tunnels were not nearly as full of beetles as those which I had previously examined; there was, however, a larger proportion of males.

On the 12th of December Mr. Wright wrote further, “ I will try the remedy you propose at once, and fervently hope it will bring me some relief from this dreadful pest, this making the third year that I have had them. I lost about forty trees last year by this beetle, chiefly Victorias, but some few Egg-plums. It has not yet, as far as I can see, touched either the Apple or Pear-trees. I find it generally in the body of the tree, but in a few cases have found it in the branches. I had some, when I found they were attacked and appeared dead, sawn off to within three or four inches of the ground, and the root is still living. All the trees that I have within a few (and these few I had from Evesham eighteen months ago), have been grown on the ground. Two or three gardeners near me have also got them, and I was in an orchard at Hartlebury, a village about four miles from here, and found that they had made a terrible slaughter; and again, at another farm in a different direction, seven or eight miles from here, I found it was at work.”

One of the peculiarities of the attack of this beetle recorded by recent observers is that it may make its appearance suddenly, do great damage, and then as suddenly disappear. This is recorded by Herr Bernard Altum in his ‘Forst Zoologie,’ in which he mentions that he has himself found many kinds of deciduous trees infested by it to a considerable degree, namely, Apple, Pear, Plum, many kinds of Alder, Beech, Oak, Chestnut, Maple and Hawthorn.

Schmidberger notes it in his experience as especially infesting Apple-trees, though also found to some small amount in Plum-trees; and in the case of the attack at Toddington Captain Corbett informed me that it appeared up to the date of writing, Sept. 17th, only to have affected the Pershore Plum-trees, which is, as he remarks, “ a curious circumstance, as it is originally a wild plum and very hardy.” Mr. O. Janson tells me that he only met with it in the New Forest in Hants.

In every case submitted to me the attacked trees were free from scale and moss, and apparently perfectly healthy.

Prevention and remedy. Where the trees attacked are still young, —that is, still only (as at Toddington), about three quarters of an inch

across the stem, the only course to be advised is to cut them down as soon as they are found to be infested, and to burn the part containing the beetles. It is no waste, for in the case of young trees the beetle-borings are rapidly fatal.

In Nova Scotia, plugging up the beetles in their tunnels with wooden pegs was tried, to prevent them escaping, and the plan being too tedious, sharp nails were substituted, but the result was not successful. "Those that were plugged in on Saturday were coming out in other spots on Monday."* In one case, however, plugging was found to cure the attack. Where, however, the attack has been established (as mentioned at p. 97) for some years, it is very difficult to see what can be done. Trees that are dying from attack ought of course to be cut down, and the infested part burnt, but the only general measures available appear to be those suggested by Mr. Fletcher for use in the Nova Scotia Apple orchards, namely, of coating the trees with some wash or mixture which will not hurt the bark, but will prevent the beetle getting in or getting out. One application advised for trial is a thick coat of whitewash with some Paris-green in it.

Another is the thick soft-soap wash known as the "Saunders' Wash," thus noticed:—"Soft-soap, reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water, is perhaps as good a formula as can be suggested; this, if applied to the bark of the tree during the morning of a warm day, will dry in a few hours and form a tenacious coating not easily dissolved by rain" (see p. 28 of Mr. Fletcher's Report previously quoted). In a communication which Mr. Fletcher was good enough to send me on Nov. 29th, he further mentioned:—"With regard to the soap-wash suggested for *Xyleborus dispar*, I have this year suggested the addition of carbolic acid, which I feel sure will have a good effect."

It might quite be expected that just enough to scent the application, without being enough to hurt the bark, would act well; but it can hardly be too strongly urged on fruit-growers that they should be on the alert, and on the first signs of attack take measures accordingly. The little shot-like holes, with very possibly sap oozing from them, or possibly wood-dust thrown out, are signs to be looked for, and measures to destroy the beetle before it spreads should be taken at once.

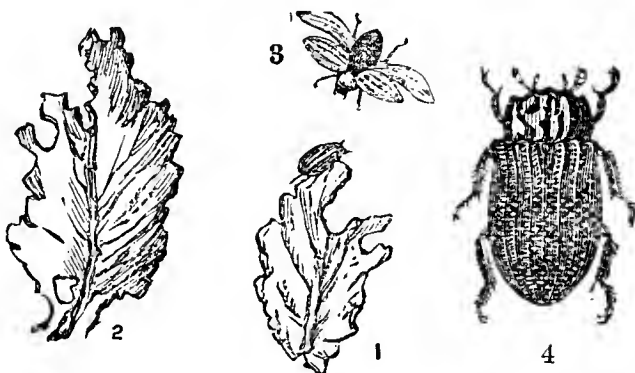
We chiefly know of it here as having severely injured Plum-stems and branches; but the European and American names of "Apple-bark Beetle," "Apple-twig Borer," and "Pear-blight," as well as its recorded habits show that it needs looking after in good time.

For further notes on habits and means of prevention, see APPENDIX.

* Report of 'Entomologist' Department of Agriculture, Canada, p. 27.

T U R N I P.

Turnip "Clock" (Turnip Mud-beetle), *Helophorus rugosus*, Oliv.;
H. fennicus, Stephens.



HELOPHORUS RUGOSUS.

Beetle, flying, and in act of gnawing leaf; also magnified (after figure in Rye's 'Brit. Beetles'). Turnip-leaf gnawed by *H. rugosus*, life-size and magnified.

On June 25th, 1889, Mr. John Milne, of Inverurie, Aberdeenshire, forwarded me specimens of the little brown beetle figured above (mag. at "4"), with the information that they were destructive to the Turnip crop in its early stages. These beetles proved to be of the species scientifically known as the *Helophorus rugosus*; but they do not appear to have any popular name, excepting that of "Clocks," which is applied to so many other beetles that it is no great distinction. Therefore, as a characteristic of this family of the *Helophoridae* is for the beetles to be often covered with mud or dirt, and this special kind has now been observed for many years to attack Turnip-leafage, the name of "Turnip Mud-beetle" might be taken (on the same principle of naming as that of the Beet Carrion-beetle) as conveniently describing the mixed nature of its habits, or places of resort.

The beetles are about a quarter of an inch long, of various tints of a rusty red colour, the thorax (body behind the head) slightly waved at the sides, and with five grooves, more or less bending and interrupted, running along it. The wing-cases greyish or ochry, with rows of punctures, and the alternate spaces between these raised in a smooth, clean, narrow ridge. The legs, and horns (which are slightly clubbed at the ends) pale; and scattered dark spots on the wing-cases. Where the thin film of mud still remains, the beetle looks of a kind of general grey colour, but by carefully working this with a moistened camel's-hair pencil the mud will be dissolved, and the beetle appear with its true colours and variations of surface.

With regard to the habits of this family of beetles (the *Helophoridae*), Prof. Westwood says:—"They inhabit ponds and ditches, creeping

slowly about the roots of aquatic plants, or occasionally coming out of the water and walking about the muddy banks, covered with dirt, whence the name of the typical genus; they often fly about in the hot sunshine. Whilst larvæ, their food consists of animal matter, but they are herbivorous in the perfect state.”*

The characteristic of being covered with mud was certainly more or less present in the case of the specimens sent me; and other characteristics, such as being found both by streams and also in dry places, and also the beetles being vegetable feeders, will be found to agree with Mr. Milne's careful observations, which I give as follows, combined from his letters of June 25th and July 2nd:—“When a field is sown in Turnips alongside one that produced Turnips the year before, not unfrequently a few of the drills nearest to the field which grew Turnips the year before are destroyed by this insect.”

“I have observed Turnip-fields attacked at the side next a former Turnip-field here and there throughout this part of the country for over thirty years. It is most seen in “crofts” (small farms), where the lots are in narrow stripes; in some cases I have seen the half of a lot next the last year's Turnip lot quite half-eaten. The mischief is done when the plants are small. “They do not seem to fly much, but I have known them destroy a few drills where a small stream divided the last year's Turnip-field from the present year's one, and have frequently seen their effects where a public road intervened.”

(Mr. Milne mentioned that in one case there was a dry stone dyke on each side of the road, in which it appeared possible that they might have hibernated). “They seem to attack the edges of fields in a dry situation, and at a distance from water.”

“In my garden here I happen to be cultivating Turnips in pots containing soils transported from different districts of the country (to test the effects of different phosphatic manures on the different soils); and the specimens sent you, and the five I now enclose, are picked from the plants in these pots. Single plants in each pot only are grown, but in another box I enclose a small Turnip-leaf from which I picked two beetles evidently in the act of consuming the leaf.”
—J. M. (This leaf is figured at p. 99).

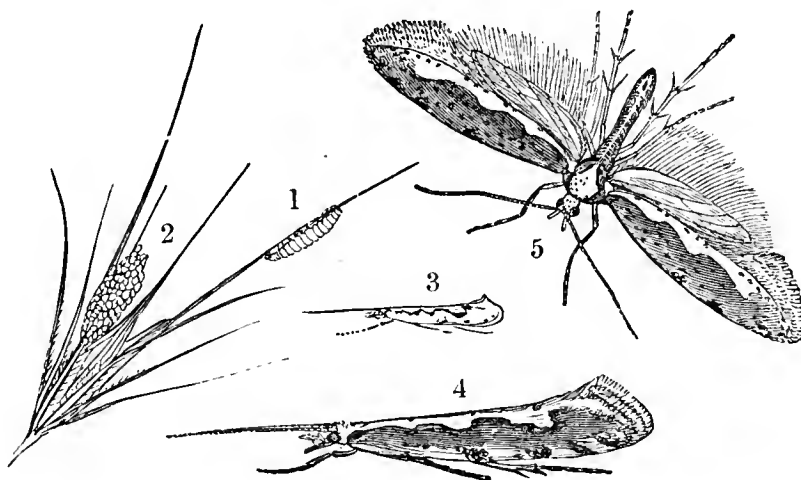
Prevention and remedy. — Mr. Milne mentions that:—“Some farmers think that a line of Oat- or Barley-chaff between the former Turnip-field and the young Turnips will prevent injury”; but this is the only idea even, of a remedy, which I can find, and until we can make sure of where the maggots feed, the only hope to check or prevent attack seems to lie in the use of dressings such as are known to be of service in the case of other Turnip-leaf infestation, as those of Flea-beetle or Sawfly-caterpillar.

* Westwood's ‘Classification of Insects,’ vol. i., p. 121.

If these dressings were strewn early in the morning, or in the evening, when the dew is on, and consequently the dust would adhere to the leaves, there would be good reason to hope that they would do good; at least the plan would be worth a trial, as on a small quantity of land this could be done very thoroughly at small expense.

Notes of useful dressings will be found in the following paper, which gives observations of successful applications of the above kind in the case of attack of Turnip Diamond-back Moth-caterpillars to Kale.

Diamond-back Moth. *Plutella cruciferarum*, Zeller; *Cerostoma xylostella*, Curtis.



PLUTELLA CRUCIFERARUM.

1, Caterpillar; 2, eggs; 3—5, Diamond-back Moth, nat. size and magnified.

The caterpillars of the Diamond-back Moth are at times exceedingly destructive, and in 1883 and 1884 I had observations of them as being mischievous to leafage of White and Swede Turnip, Rape, and Kohl Rabi. The localities from which specimens were sent were chiefly various parts of Yorkshire, and near Inverurie, in Aberdeenshire; but notes of severe attack which appeared to be of the same kind were sent in 1883 as occurring in the district near King's Lynn, in Norfolk, also from Watten Mains, Caithness, N.B., mentioning prevalence on Turnip-fields on the seaboard. In 1884, Mr. Tait, of Inverurie (who had himself identified the moths) wrote me in August that he had seen several fields in different localities all more or less affected, and that by report he considered the attack must be general over the north-eastern district of Scotland.

From 1884, I had no further reports of the presence of the infestation until the autumn of 1889, when I was favoured by the following communication (with specimens of caterpillars accompanying) from Mr. Henry Ross, of Chestham Park, Henfield, Sussex. This is of very serviceable interest, as previously very little was known as to there being any good working remedy.*

* As this attack is especially destructive to Turnips, the note stands best under this heading, though the special injury in the above case was to Kale.

Mr. Ross wrote on September 30th as follows:—"I enclose a caterpillar with the leaves of the 1000-headed Kale, on which it is feasting; the Kale is just above the ground (one inch) and was drilled on a clean summer fallow, with farm-yard manure. I have ordered 100 bushels of soot for three acres, which I purpose sowing at once, in the hope of checking this pest, which will otherwise destroy the crop."

I suggested a dressing should be applied of gas-lime, lime, soot, and sulphur, as recommended by Mr. Fisher Hobbs for Turnip Fly (this to be sprinkled when the dew was on, so that the dust would adhere to the surface of the leaves), but the soot proved sufficient for the purpose, without any additions.

On August 8th Mr. Ross reported:—"I used soot lavishly, and the effect was as you surmised—the plants went off at a jump, and continue to grow, leaving the caterpillar behind." On my requesting further details, Mr. Ross wrote on January 13th:—"The Kale is perhaps from three to four inches high, and looks most kindly; as our ewes commence lambing early next month it is a most important crop with us. There is not a hedge, tree, or fence of any description within 300 yards of the field. . . . It was also a summer fallow, ploughed and stirred continuously, and yet the pests came. Our first attempt with soot was useless—not enough; they were under the leaves; but I thought an extra dose would fertilize, if nothing else. So we sowed broadcast 100 bushels of soot per acre; we were fortunate in our weather—a humid morning, every leaf holding moisture. The whole field was black with soot, we could not find any caterpillars, and the Kale has been growing ever since."

Up to the present time this attack has been so seldom brought under my own notice that there has been little opportunity of experimenting on it; and the only applications which have been reported as doing good are nitrate of soda, which pushed on growth, and also sweeping the infested leaves with light branches tied to scufflers, so as to brush off some of the grubs. The great difficulty in treating this attack has been by reason of the caterpillars feeding for the most part beneath the leaves, so that the dressing thrown upon the leaves did not injure the grubs; but it will be observed that Mr. Ross particularly noticed this habit in the course of the operations, and by applying the soot, to use his own term, so "lavishly" that the whole field was black with it, and (from the dampness of the leaves) the soot adhering, the difficulty was got over.

The female Diamond-back Moth lays her eggs on various plants, but most especially on Turnips, Swedes, or plants of the Cabbage tribe, wild or cultivated. The caterpillars are about half an inch long when full-grown, somewhat spindle-shaped, and of a pale green colour, with

a grey or yellowish head, some small black spots on the ring next the head, and two yellow spots on the back of the two succeeding rings.

The caterpillars feed voraciously, in bad attack clearing away the substance of the leaves down to the ribs, and sometimes gnawing away these also. When full-fed, they turn to chrysalids in cocoons spun of open network on the infested plant, or on the surface of the ground, from which the moth comes out in somewhat over or under a fortnight.

These "Diamond-backs" take their name from the peculiar shape of the white or pale markings on the hinder margin of the fore wings. When these are folded together, the connected marks form a series of diamond-shapes down the middle of the back. The moth is variable in general tint, but may be described as more or less brown or greyish. The hinder wings are grey or ash-coloured.

The species is very widely spread; it is stated to extend all over Europe, and I have had specimens of the moths and caterpillars, with a sample of Cabbage-leaf injured by them forwarded from S. Africa by M. de Witt Meulen, of the Winterhoek, Cape Colony. Heavy rains or frequent watering of the leaves were noted accompanying as destroying many of the grubs, and also that where the Cabbages were planted in rows they were protected on each side by a line covered with some sticky substance, as molasses. "Many moths were thereby prevented depositing their eggs on the plants."* This plan (with the alteration of substituting any cheap sticky material that would attract the moths, for the molasses) might be very serviceable here for garden use.

Details of the Diamond-back Moth-attack are given in my Reports for 1883 and 1884; therefore I have not repeated them here, but the point of stopping attack in full course by dressings appears worth separate mention.

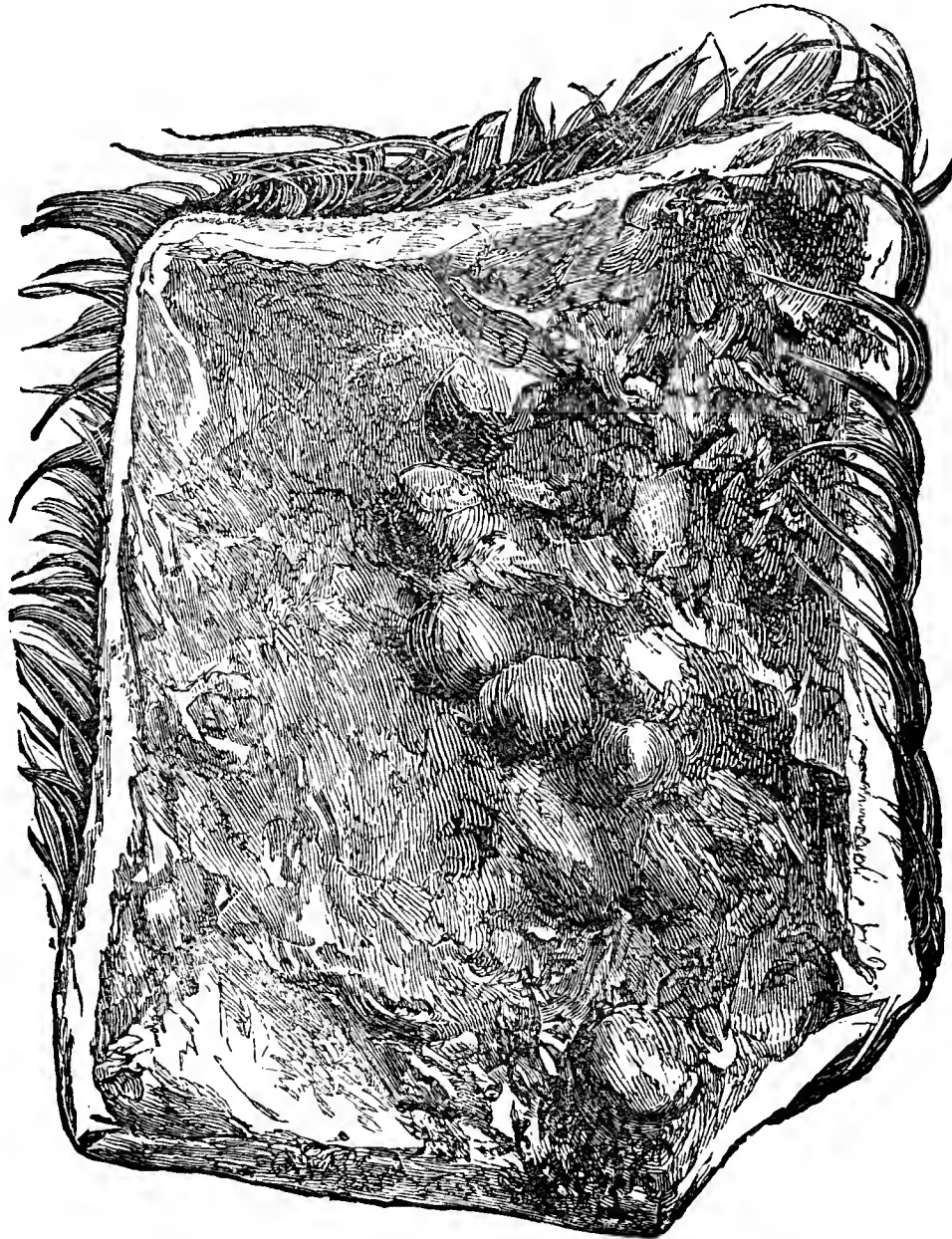
WARBLÉS.

Ox Warble Fly, or Bot Fly. *Hypoderma Bovis*, De Geer.

During the past season the subject of Warble-attack has met with steadily increasing attention not only in this country, but also in the United States of America; and attention is now being drawn to it, or will shortly be so, in Holland; and last year (as well as in each successive year since the investigation was especially carried on) the reports from cattle-owners, farmers, and others able personally to judge of effect of the treatment recommended, confirm the ease with which, for all practical purposes, Warble-attack may be got rid of by

* 'Observations on some Injurious Insects of S. Africa,' by E. A. Ormerod (Simpkin & Co., London), p. 47.

the use of the remedies suggested. Besides this, the main point of the observations of the past year has been the proof from examination of the carcasses of warbled beasts after removal of the infested hide, that Warble-attack, when severe to an extent often found to be the case, causes inflammation, and consequently very evident alteration in the state of the tissues immediately beneath the warbled part of the hide.



Piece of under side of warbled hide ; Warbles about half size. From a photo. by Messrs. BYRNE, Richmond, Surrey.

This condition, known as "licked beef" or "jelly," was only too well known to all connected with dressing cattle after slaughter, but the nature and precise cause of the condition was *not* known. Now, however, that it is ascertained to be inflammatory product caused by irritation of Warble-presence, this matter is one that farmers should know about fully, as it lessens the returns to them (as shown at p. 111 in the report from Mr. Sparkes, of Wearhead, Darlington), from the beast not answering in condition to the amount of good food given. Also, where butchers know what the presence of bad Warble-attack *showing outside* means as to the state of the carcass *beneath*, there will be a further loss to the seller at so much per stone to counterbalance the butcher's loss in having to scrape the meat.

For years back notes have been sent me of the wasting, and illness, and death of badly-warbled animals, but it has been only during the past year that, by special desire of many who were money-losers from this cause, I have been enabled, through *post mortem* examinations, to lay clear proof before my readers of connection between presence of inflammation seriously injurious to condition of the animal and presence of Warble in the overlying part of the hide.

In the following notes it will be seen that I am indebted to Mr. John Penberthy, Professor of Pathology at the Royal Veterinary College, Camden Town, N.W., for report on condition of specimens sent. To Mr. Henry Thompson, M.R.C.V.S., of Aspatria, Cumberland, who has long devoted much attention to Warble-treatment, for procuring specimens, and also for technical description; and also to Mr. John Child, Managing Secretary of the Leeds and District Hide, Skin, &c., Company, for much useful information, and a very serviceable specimen. These are the contributors to whom I am especially indebted for specimens. The investigation was long and laborious, and I was much favoured also by assistance of the gentlemen whose names are appended to their contributions, whose influential position and special knowledge of the subject enabled me to work out the matter; but I wish especially to point out that, though the condition is only *demonstrable* after death (so that it is from the dressed carcase that we must learn what has been going on), the diseased state is to the full as important, or more, to farmers as to the butchers in whose hands the state of affairs comes to light.

The reasons for the name of "licked beef" being applied to the altered condition, and a description of this altered state, is given in the following observations, with which I was favoured in reply to my enquiries by Mr. Henry Thompson, M.R.C.V.S., Aspatria, Cumberland:—

“With reference to what you call ‘licked beef,’ I suppose you mean that portion of the back (sirloin) where the Warbles are generally most numerous, and, when ready to leave their quarters, cause so much irritation that the cow licks them with her rough tongue, and assists in their removal, and is thus thought by many to damage the flesh underneath; hence the name, ‘licked beef.’ But I cannot see this; the heavy, thick skin will protect the beef from being damaged with the cow’s tongue; therefore, in my opinion, the term ‘licked beef’ is a misnomer.

“Now, what causes the damaged meat, or beef, is the chronic inflammation set up by the Warbles in the skin, which extends to the connective tissues, thence to the flesh, producing the straw-coloured, jelly-like appearance of a new-slaughtered carcase of beef, which in twelve to twenty-four hours, when exposed to the air, turns a dirty

greenish-yellow colour, and this spoils the beef, having a frothy discharge oozing from the surface, with a soapy-like look; hence the name, 'licked beef.'—H. T.

Though licked beef was plentiful enough, yet there was immense difficulty in getting specimens with the warbled hide still attached, so that we might have the *proof* absolutely before our eyes of immediate connection of the diseased state with Warble-presence. But on the 17th of May a very good specimen was sent me by favour of Mr. Henry Thompson from Workington, in Cumberland. This was a large piece, containing the back-bone, flesh, and hide, all cut right out of the centre of the animal after slaughtering. Altogether this weighed over four stones, and was an excellent specimen for our purpose, because it was so very moderately warbled that it showed how mischief may arise, even from an average or less than average amount of Warble-presence.

Regarding this specimen, Prof. Penberthy (who kindly examined it for me) wrote me from the Royal Veterinary College on May 20th:—
“The parcel arrived quite safely, and its contents in good preservation. I fear that this time again we have not a very serious attack. In a superficies of 450 inches I found eighteen well-developed, and eight very small Warbles. There was, however, ample evidence of inflammatory products.

“The changes had not apparently affected the red flesh (muscles). It so happens that in the parts more seriously invaded the muscles are covered with dense fibrous tissue.

“This morning, in those parts in which the Warbles were most numerous, putrefactive change was much more advanced than in those in which there were no Warbles.”—J. P.

In this case we had only a beginning of bad effects from a moderate attack; later on a sample of the “jelly,” or inflamed tissue scraped from an infested animal, showed (as noted below) the diseased state very perfectly. Regarding this material, so to call it, Mr. John Child, Managing Secretary of the Leeds and District Hide, &c., Company, wrote me as follows:—

“In the worst parts of the Warble season I could get you bucketsful of inflamed tissue, commonly called by the butchers ‘jelly,’ cut and scraped from the carcass after the hide is taken off. The formation of this inflamed matter must be a great drain on the health, condition and quality of the animal, and must be a great loss to somebody.”—J. C.

The height of the Warble-season was then quite past, but on July 16th Mr. Child forwarded me a sample of this so-called “jelly,” with the remark that it was “difficult to get at this time of year. When the grub leaves the hide, the inflamed tissue soon diminishes, and in a very few weeks disappears altogether; but during the most active part of the Warble-season the condition of the carcass of the

animal is such as to considerably reduce the value to the butcher.”
—J. C.

This disgusting-looking sample of scrapings from the inflamed surface appeared to the unpractised eye as a mass of variously discoloured, soft, wet, or jelly-like-looking material, in which there were here and there orange- or ochre-coloured patches or streaks, and dark red lumps or patches like coagulated blood; and in this material, or jelly, the Warble Maggots were still to be found.*

This sample I forwarded by his kind permission to Prof. Penberthy, who wrote me regarding it as follows:—“I have made an examination of the *post mortem* specimen sent. The so-called ‘jelly’ is the product of inflammation, and there is every reason for believing that this inflammation is due to the Warble. In the small portion of material received there were three apparently healthy Warbles, evidence of two others in a decomposing state, and three cavities where other Warbles had been lodged. The material is not fit for human consumption. I think it very deleterious to the health and comfort of the affected animal.”

In reply to my enquiry as to how I should rightly describe the altered tissues, Prof. Penberthy wrote me:—“I should call the material inflammatory product in the subcutaneous tissues. . . . Inflammatory product is made up of constituents of blood exuded through vessel-walls which have been damaged. It is allowed, too, by some pathologists that inflammation, too, may excite growth of the cells previously existing in the part. The dark red colouring is most probably due to escape of blood from small vessels which have ruptured; the orange-coloured material which I have found in some cases is inflammatory product undergoing degenerative changes, in others decomposing Warbles.”—J. P.

A few days later Mr. Child further wrote that the sample which he sent me of inflamed tissue was obtained from the animal while in the process of dressing, so that the inflamed matter was taken both from the hide and the carcase at the same time.

“In watching the slaughterman take off the hide, we were surprised to find the Warble-grub present, a somewhat rare case so late

* The reader will please observe that in these notes I am entirely limiting myself to observation of the nature of the mischief caused by Warble-presence. Inflammation may be caused by injury to the animal, or local disease, or it is considered sometimes to arise from too-high keep given to push on the condition of the animal rapidly; but *the* great cause of the alteration under consideration is Warble-presence, therefore I have only given the anatomical results of examination of specimens where we had the Warble-presence in connection. The mischief itself and its origin from Warbles we have ample evidence of for many years back; but the point especially asked for was to learn what this changed state was, anatomically considered.—E. A. O.

in July; however, it enabled me to send you a perfect sample on a small scale. But during the worst part of the Warble-season they sometimes cover one-third and in some few cases one-half of the entire carcase; the Warble always develops on the top of the animal from the shoulder to the tail-head, which spoils the choicest parts of the carcase, ruins the best parts of the hide, and makes it worthless when tanned for many purposes, namely, for harness, engine-straps, boot-soles, &c. The effect on the carcase of the animal afflicted with Warbles in regard to colour is, when quite dry after dressing, in some cases a pale yellow, in others a light brown, and in some scarce examples dark as mahogany."—J. C.

In the above communication it will be seen that Mr. Child (though only in a few words to each subject) draws attention to several points of very practical importance, especially that of the large extent of the upper side of the animal which is liable to be covered by Warbles (a fact of which I have plenty of proof in my hands in the specimens of hides sent me so pierced by Warble-holes, even up to over four hundred in number, that no word but "riddled" can convey the perforated state); and also Mr. Child notes the great depreciation of the value of the warbled hide by reason of the unsoundness making it comparatively useless for leather-manufacture.

The following communication from Mr. C. E. Pearson (wholesale butcher), Sheffield, is valuable both from the practical information conveyed, and pointing out extent to which Warble-presence unavoidably tells against the health and thriving of the infested animal:—

"In answer to yours of March 9th, I may say that the effects of Warbles on the carcase is more serious than can possibly be imagined by an outside appearance of the beast. The beef, as I stated in my letter to the 'Meat Trade's Journal,' is most unsightly, but the taste of the beef is very bitter* where the Warble has been, and very objectionable to the consumer. The carcase of beef assumes a nasty yellow colour, and also a soft, flabby appearance on the outside rind of the beast (where the Warble has been in operation); so much so, that the carcase has to be pared in some cases down to the flesh to make the appearance of the animal at all presentable for the market, thereby causing a grievous amount of loss to the butcher, and an unsightly article to the consumer. I am of course speaking from experience, killing on an average twenty beasts or more a week, and the loss to me alone in hides last year amounted to something like £3 per week during the season that Warbles had developed on the hide, and no one a gainer.

"There are various theories in respect to beasts developing the

* For further observation on taste and quality of beef from an infested animal, see pp. 110, 111.

Warble; some say that a beast in good condition will sooner develop the Warble than one in poorer condition. Of course that is an open question, and I rather favour the latter opinion, having noticed that poor stores beasts from Ireland seem more subject to them than our English stores which are in a better condition and that have been better housed. Be that as it may, they are a pest not only to the butcher as a matter of loss, but, from a humane point of view, to the poor beasts that suffer from them. . . . causing a great amount of pain that might be avoided if only the farmer would be at the trouble *to try at least* to rid them of the pest. Of course, while the animals are suffering physical pain the owners themselves are suffering in pocket, and more than they imagine; the loss results from the lowering of the condition of the cattle, and the dairy-farmer loses from the yield of milk, not only reduced in quality, but also in quantity, and it is an impossible thing for the general health of the cattle to be so good when suffering the excruciating pain caused by the Warbles.”—C. E. P.

The letter from which the above extracts were taken was forwarded by me, according to Mr. Pearson's request, to the Editor of the 'Meat Trades' Journal,' where it was inserted at length in the number for March 23rd, 1889, with the following observation:—“We should like to urge upon our traders the value of such correspondence, giving their practical experience. It is essential, in discussing this serious grievance, that the condition of the carcase, as well as the hide, should be prominently brought forward. Details as to the loss caused by paring the carcase, &c., are wanted, as also a veterinary report dealing fully with the *post mortem* appearance of the flesh.”—(Editor of 'Meat Trades' Journal,' Liverpool).

In answer to an enquiry of mine whether the alteration in the carcase, called “licked beef,” takes place only where the beast can lick the place, Mr. Pearson replied:—“It will take place whether the beast can lick it or not, as there is the irritation continually going on; of course licking aggravates the case, and makes the carcase worse.”

Much communication on the subject passed through my hands during the investigation, but without entering on all these, the above notes, with the addition of the two following short notes with which I was favoured, are quite enough to show the nature of this diseased condition consequent on Warble-attack.

The first is from Mr. Joseph Wing, Hide Broker, of Pen Street, Boston, who noted from his own observations as to condition of warbled beasts:—“The effects are something as you state. There is a jelly or watery substance on the back of the carcase when dressed, on and between the rind or thick skin and the bone of the beast.”

The following note was given me at the beginning of April by Mr. John Risdon, of Golsoncott Farm, Washford, Taunton (Auctioneer to

the Devon Cattle Breeders' Society) :—"I received your communication on my way to Taunton Market on Saturday; one butcher, well known to me, and a man of great experience, told me he killed a bullock a few days before so discoloured by licking the Warble-grubs that he had to scrape off nearly the whole of the spine (fat) to render the carcass presentable for sale."

I have myself also had the opportunity of seeing the altered state and colour of parts of the surface of a carcass from which the hide, when removed, had been found to be so infested with Warbles that I was asked to come and look at it. This was at Spring Grove, near Isleworth, and the butcher cut thin slices off the discoloured yellow part to show me how much the condition was altered from that of the healthy portions (E. A. O.).

How far the altered condition of the surface may affect the taste of the meat does not seem certain; I have only had a few reports on this subject, but from these, most of the evidence appears to lean to the taste *being* altered.

In the following notes, kindly procured for me by Mr. McGillivray, Secretary of the Hide Inspection Society, Newcastle-on-Tyne, from butchers of that town, it will be seen two of the writers consider the taste to be altered, but the other writer does not:—

Mr. M. H. Penman, Gateshead, writes:—"Your letter to hand. There is nothing nastier than licked beef, and the worst of it is that it is always licked on the most expensive parts, *viz.*, the back, which comprises the sirloin and forechain; and it is quite true that it not only gives the beef an unpleasant appearance, but a nasty, bitter taste. If I knew, I would not buy a licked beast, supposing I could get it at a shilling a stone less."

Mr. W. C. Brown, Newcastle, writes:—"In reply to your note of to-day respecting 'licked beef,' my experience teaches me that the quality is not at all deteriorated; it interferes very much with the outward appearance, and more if the beef hangs for a week or more; the colour becomes somewhat darker, but certainly it *has not a bitter taste*, for only on Sunday last we cooked a piece (of beef of that character) from an animal slaughtered ten days before, which was very much licked, and beef of better quality no one could eat."

Mr. Wm. Thompson, Newcastle, writes:—"When beef is badly licked, it is very bitter; I have seen it quite unsaleable, all the outside fat taken off, and you could not get the bottom of it. Sometimes it is so bad that it is right through the chain and down to the rib-bone, when it is as bad as that it is quite useless. We must carry on the crusade until the Warble-pest has been annihilated."

It is perhaps worse than useless to venture a conjecture where

those who thoroughly understand the subject differ amongst themselves in opinion, but it does occur whether the difference in bitterness of taste may not be according to the completeness with which the diseased tissues above the meat may have been removed (E. A. O.).

The view that the quality of the meat is *deteriorated* consequently on Warble-presence in the animal from which it is taken is confirmed by the following abstract given by Prof. Riley, Entomologist, U.S.A. Department of Agriculture, from a notice of the results of the very widely-extended investigations regarding Warble-attack made during 1889 by Mr. A. S. Alexander, Member of the Highland and Agricultural Society of Scotland (and while still in this country one of my own contributors), now Editor of the 'Farmer's Review,' Chicago, in which journal the original papers appeared:—

“Without considering the lessened quantity, the inferiority of the beef of animals infested by the grub is strikingly shown in an article on the subject, in which the testimony of retail butchers and buyers of meat in Chicago and other cities is given. It is shown that the buyers of the highest class of meat who supply hotels and restaurants will not on any account purchase carcasses showing traces of Warble-attack. Such beef has to be sold, therefore, at a price below that obtainable for good beef, free from grub-damage, and the lessened value per animal was put at from two to five dollars.”*

For years observations have been sent me of cases of wasting-away or even of death accompanying bad Warble-attack, and, on the other hand, of the good effect on the animals in fattening well and milking well where Warbles were kept down, as in the Bunbury district, by the united action of the farmers' sons; but this can be turned to in my previous Reports; and now relatively to the loss caused to the cattle-owner by neglected or overlooked Warble-attack, I give the following detailed note.

On April 10th, Mr. James Sparkes, of Wearhead, Darlington, forwarded me the following information regarding loss consequent on bad Warble-presence in the case of a Heifer he had lately sold:—

“I recently sold to a butcher here a very good Heifer, which turned out a much lighter weight than I anticipated from the extra good feed, &c., and much surprised to find the poor animal had been one of the martyrs, hide considerably reduced in value, and understand some parts of the meat had to be scraped to be made presentable. I will now take good care this shall not occur again, having procured McDougall's Smear and careful inspection.”

A few days later, in reply to my request for further details, Mr. J. Sparke wrote me that the butcher had found the badly-warbled animal

* “Insect Life.” ‘Periodical Bulletin of U.S.A. Department of Agriculture,’ No. 5, vol. ii., p. 157. Washington.

above-mentioned:—"Down the spine was frothy, loose, and mattery, or suppose in a sort of jelly-state, and (as I said in my last) some of the beef to scrape before sending it out. The loss on hide, 1*d.* per lb.; suppose that would mean on hide, 5*s.*

"Now loss in beef fell upon myself, the animal being sold to the butcher so much per stone. But (as I said before) the Heifer did not make near the weight I anticipated from the extra good feed and length of the time she had. It should have been at least six stones more, so may venture to say, loss in beef and hide from fifty to sixty shillings. I never suspected Warble-trouble until told by the butcher."—J. S.

He also mentioned an instance of an animal belonging to Mr. Henry Robson, of Glen Hill, Allendale Town, Northumberland, which had been doing very badly for some time, which proved on examination so badly infested that the owner removed sixty-nine Warble-maggots, and found a great many more not sufficiently matured to squeeze out. He used the smear, and, like some others, fancies he will see this does not occur again.

The above notices confirm the observations given in my preceding Reports from leading cattle-owners and farmers, and also from butchers and tanners who have examined the carcasses and newly-removed hides immediately after death, regarding the quantity of cattle that die, or demonstrably are seriously injured in health, by maggot-presence. At pp. 112–113 of my 'Twelfth Report' are some special notices from cattle-owners of this matter.

I add one very serviceable observation sent me in 1887 by Mr. Henry Thompson, M.R.C.V.S., of Aspatria, referring to the inflammation and illness caused by Warble-attack to a Heifer placed (for this reason) in his charge, and giving the recipe for the dressing used to cure the attack:—

"Last year about this time I was called in to a little three-year-old Heifer, whose back was almost covered with Warbles, and the effect on the constitution was very marked; the poor thing was very thin, and would not eat; I was satisfied that the irritation set up by the Warbles was the cause, and applied the following:—Turpentine, 1½ oz.; sulphuric acid, 1 drachm (here a chemical action takes place, and must be done with caution); to this I added 10 ozs. raw linseed oil, and rubbed the cow's back once a day with the mixture.* In a fortnight the back was cleaned, and all the maggots destroyed."—Henry Thompson, M.R.C.V.S., Aspatria, Cumberland, April 11th, 1887.

The observations of cattle-owners have shown for years that the stock is so much improved in health by being saved from irritation in the back, that thus the better milk-supply and the fattening of the beasts

* The sulphuric-acid, turpentine, and raw linseed-oil mixture is an old preparation (very old), and is known by the name of "black oils."—H. T.

is decidedly a gain to the farmer, without taking into consideration the prevention of casualties caused to the dairy herd by mistimed galloping, and also by cases of sickness and death.

Very great progress has been made in prevention, and it could not be expected that an evil of such long standing should be undermined at once; but the great difficulty in making progress (that is, the difficulty of those who understood the needs of their cattle, as owners and breeders, agents of large properties, and farmers all over the country) has been that there were many who *would* not believe, or at least would not acknowledge, that the attack was a loss to the owner.

At first we had to meet the old idea that the swellings were nothing but "health-bumps!" By years of work (although this misconception still lingers amongst the ignorant, *and the allegation that it is so* amongst those who wish to get injured beasts off their hands at price of good ones) we have disproved with all instructed observers this "boil theory" by showing that the cause of the swelling is a growing maggot. Still, however, one of the points constantly brought before me in letters from *farmers who were themselves* carefully attending to their stock was the manner in which general stamping out of the pest was impeded and delayed by those who alleged it was of no use troubling themselves, for they "would not get a penny more for a beast without Warbles!"

But now, in the direct proof given by the long-known occurrence of "licked beef" (*i. e.*, inflammation to an extent to alter the condition of the tissues of the animal) being brought forward *demonstrably* in connection with much maggot-presence, we put in the hands of vast numbers *who wish to know*, a reason of the failing of their beasts which otherwise they would not so fully have understood, and also enable them to point out to their neighbours *how to look for and cure* what otherwise would be a probable cause of much loss.

The treatment to stamp out the pest (to all practical purposes) is simple, cheap, very easily applied, and sure in effect. In the copy of the Warble leaflet appended (of which it will be seen the circulation has now reached beyond a hundred thousand) the main points of Warble-attack and the main points of treatment are shortly given.

Those who wish to study the kinds of dressings most used, and methods and effects of application, will find them in detail, with name and locality of observer appended, in previous Reports, especially at p. 103, and at pp. 112-114 of 8th Report; pp. 89-96 of 9th Report; pp. 96-98 of 10th Report; pp. 110-111 of 11th Report; and pp. 105-110 of 12th Report.

Any treatment will answer which will either remove the maggot bodily whilst still alive from the Warble-cell, or will destroy the maggot in the cell, without giving pain or risking injury to the infested

animal, or those pasturing with it, which might lick off poisonous dressings.

Where the maggot is advancing to full growth, probably squeezing it out is the best remedy of all, that is, in case the infested hide is not too sore to bear pressure.

If dressings are preferred, the numbers of kinds that will answer the purpose are endless. All that is needed is that the grease or mixture should be thick enough, and tenacious enough, for a little "dab" of it, when placed on the opening of the Warble, to adhere firmly, and thus choke the maggot by preventing it drawing in air through the breathing-apparatus in the two black spots at the end of the tail, which may usually be seen in the opening of the Warble-swelling. If, besides the above, anything can be added to the application having a scent likely to deter attack, it is all the better.

In looking over the Warble Reports for 1884, and onwards, McDougall's Smear or Dip is certainly that most generally approved of; the ointment of the Dee Oil Company is well spoken of; so also is cart-grease; but amongst the very various mixtures sold under this description (see p. 59), care should be taken not to employ too-caustic a kind.

Mercurial ointment used as a *little touch* laid on each Warble, and *not* applied a second time, answers well; but it should on no account whatever be applied as a smear, nor if there are many Warbles, and, from the risk of mis-application, or of other cattle licking the dressed animal, I do *not* take upon myself to advise this kind of dressing, though under skilled direction it has answered admirably.

Train-oil and sulphur used in the consistence of thick cream answer well; also sulphur and soft-soap in the proportion of 1 lb. of each mixed in three pints of boiling water; and cart-grease and sulphur, lard and sulphur, and sulphur with paraffin, have been reported as useful for destroying the maggots.

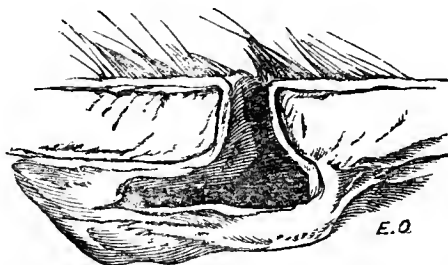
Many other dressings and washes for summer use have been duly recorded as found to answer, and in the United States returns I do not find that there is any dressing or treatment better than ours, unless it may be a greater use of salt and water, or brine for washing the coats of the animals. This is an old-fashioned but apparently very good preventive measure, which is noted by Mr. Henry Thompson as used in the North of England, and the application of it by rubbing it well on with a wisp of straw (as mentioned by one of the U.S.A. reporters) would probably be very serviceable in removing eggs; and getting the wash thoroughly in amongst the hair, and well down into the minute hair-like channels through the hide, at the bottom of which we find the maggot in the very earliest stage at which the infestation is easily observable.

These minute channels may be found as early as November 12th (giving this as the date of our own observation of them); they may be found straight down from the upper surface, or bending, or with a turn at the top running under the outside cuticle, and their connection with the little sore below, in which the maggot then lies, may be proved by gently squeezing this, when the blood will be seen running up the channel, and standing in a little drop on the surface.



Section showing maggot-track through hide, magnified.

Any safe dressings which could be applied to the hide of animals at the above date (that is, of course, of animals which there is reason to suppose are infested) would be very desirable to try, *and to report on*. At first the channel down through the hide, and the spot where the maggot lies below are merely sores or openings caused by the sharp mouth cutters of this then almost microscopic grub. *These* injuries *then* heal up readily, and early in the year also they will heal fairly well; but where the maggot has been allowed to remain for several months, working itself about in the hole, which, by its growth, it keeps pressing larger, then a kind of false skin or film forms over the surface of the cell (see fig.); and as this



Section of Warble-cell, after soaking in water.

is not got rid of when the maggot is killed, it is very apt to make a kind of plug in the hole, which prevents it drawing completely together for a long time, and thus causes much depreciation of the value of the hide, though not always noticeable by the buyer.

I am obliged by the following note on this subject from Mr. W. H. Hill, Vice-President of the Sheffield Butchers' Association:—"In one of my letters you may possibly remember my reference to the loss to the tanner on finding the *tanned hide* to be spoiled for the purpose intended, by the ravages of Warbles, and to my explaining that traces of the Warble-holes are left on the hide when tanned, even after the holes are closed up by suppuration. I have no doubt it will interest you to know that a few weeks ago a local tanner brought for my inspection a tanned hide of as good quality as can be found, and for which, being off a polled Scotch beast, and weighing 98 lbs. in the raw state, he had paid us an extra price over ordinary hides of a similar weight. When purchased in the raw state, no distinct traces of Warbles could be seen, but on being tanned, the grain-side in the best part of the hide was speckled, ragged, and blistered, where formerly Warbles had been. The tanner, who is reliable, stated the difference

in value, and loss on this one hide would be at least 25s., and probably 30s."—W. H. H.

Success of various kinds of treatment specified.—It scarcely appears worth while to give again this year a series of communications from correspondents regarding the success of methods of treatment, as each season these have almost invariably proved very satisfactory, and the records, with name and locality of contributor, have been given in my preceding Reports; but I add the following notes, as, besides mentioning the success of the various kinds of treatment, they also show how, where the treatment has been continued for a few years, the infestation is almost entirely got rid of.

On June 21st, Mr. G. F. Street, writing from Maulden, Ampthill, observed:—"Warbles are getting quite stamped out now on our two farms, as for the past three years we have not had on an average one dozen Warbles on from sixty to seventy head of cattle, mostly young stock. We always use the McDougall's Smear, and find it a safe remedy."—G. F. S.

The following note, with which I was favoured on September 21st by the Hon. Cecil Parker, from the Eaton Estate Office, Eccleston, Chester, also mentions the attack having been nearly got rid of:—"I am quite sure that more notice has been taken of the means of destroying the Warble. As far as our own cattle are concerned, we have nearly exterminated them by killing the maggot in the beast, and also by smearing the backs of the stock twice in the season. If the farmers could be persuaded that they lose money,—in cows by the milk getting less, and by the beasts losing flesh,—they would take more interest."—C. P.

Sir J. Stewart Richardson, Bart., of Pitfour Castle, Perth, N.B., writing on September 24th, similarly mentioned benefit following the care taken:—"For the last three years I have been waging war against the Warble-pest, and think I have done a good deal to alleviate the sufferings of my cattle, and the result is that I have nothing to complain of as to the way they have fed."

In September last, Mr. J. Risdon, Auctioneer of the Devon Cattle Breeders' Society, writing from Golsoncott Farm, near Taunton, mentioned that last spring he had all the animals in his own herd dressed with sulphur and lard, which, he believed, killed every maggot in their skins." He further added:—"There are many farmers who at first regarded the Warble Fly as a mere 'fad,' who are now anxious to use means to relieve their cattle of the pest."—J. R.

Mr. Henry Thorp Hincks (Auctioneer), Silver Street, Leicester, wrote on April 9th, with regard to success of preventive measures:—"Out of a herd of over seventy head dressed last year for Warbles, this season one cow only has one Warble upon it."—H. T. H.

Mr. Edw. Argyle, writing from Tamworth on March 14th, remarked:—"I am an amateur breeder and keeper of stock, of which I am very fond, and I have been much interested in this question; and have had my cattle dressed with train-oil, common salt, &c., and I have found that as a consequence they have to a great extent escaped the attack of the Bot Fly, and no doubt much suffering." Later on in the year, writing on September 24th, he favoured me with the following report of continued success of his treatment during the summer of 1889:—

"I am glad to say that I believe the fly has not been anything like so troublesome about here this season as it has usually been. I have never seen my cattle at all distressed by it. I may mention that I have employed common salt for the destruction of the grub this season with good results. I bought some young cattle of very nice quality in the early summer; they were terribly infested with grubs. I had their backs damped, and salt well rubbed in, and this was repeated about a week later. The result was that every grub was destroyed. I had all my cattle dressed over with train-oil before turning them out permanently, and they appear to have done well and escaped the fly. If all stock-keepers could be induced to adopt some such simple expedient, the fly might soon be stamped out."—E. A.

Mr. S. Conyers Scrope, writing from Darley Hall, Bedale, Yorks., mentioned with regard to Warble-maggots:—"I have for long been in the habit of carefully searching my winter beasts for them about March or April, before turning them out for the summer, and have had the satisfaction of seeing them quiet and contented during the heat of summer, whilst those of my neighbours seemed driven mad by the Warble Flies."—S. C. S.

On July 15th, Mr. George S. Rodger, writing from Harelaw Farm, Barrhead, N.B., mentioned as follows:—"We used the sulphur, spirits of tar, and oil mixture for the first dressing for the Bot Fly last year on our dairy stock, but, as the smell was rather disagreeable to the milkers, we used a solution of McDougall's Dip afterwards, with the result that there were only one or two Warbles on the whole stock this spring, whilst some bought-in cows were very badly affected with them. So we have continued to use McDougall's this year also, and they have settled extremely well through all the hot, dry weather, and prevalence of 'Gad-fly' that there has been, which I think annoys them, and sets them galloping about the fields as readily as the Bot Fly."—G. S. R.

Mr. Fred. Rose, writing on November 7th from Boiling Wells Farm, Sleaford, Lincolnshire, remarked:—"On the appearance of Warbles on any beast, I immediately dress them with train-oil and tar, which immediately destroys the insect, and is a preventitive."

On February 4th of this year (1890), Miss Lyle Smyth, of Barrowmore Farm, Chester, reported that (as in the preceding season):—"I have had my cows very successfully dressed with Dee Company's Oil"; and further added, "but as a matter of fact I believe McDougall's Carbohc Smear is the best and cheapest stuff for the purpose."—E. L. S.

The work of the boys of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, under the superintendence of their excellent Head Master, Mr. W. Bailey, is still being continued with great zeal and success in extirpating Warbles from the neighbourhood. On May 29th of last year Mr. Bailey wrote me as follows, accompanying a detailed and tabulated report of the work of the boys during the previous month in destroying Warbles:—

"You will notice that the total of stock examined is 577, and that no fewer than 1077 maggots have been squeezed out *and destroyed*, or killed by the applications of the ointments prepared by Messrs. McDougall Brothers, the Dee Oil Company, Chester, and Jeyes' Sanitary Compounds Company (Limited). These firms have very generously supplied us with tins of their valuable preparations, and the effect has in the case of all the dressings been most satisfactory.

"You will perhaps be struck with the great increase in the number of Warbles removed or destroyed this year as compared with those of previous years. It is thus explained. I granted to the boys this year a 'roving commission,' encouraging them to inspect their neighbours' cattle as well as their own, as far as practicable."

As Mr. Bailey says, the proportion is larger this year, but, looking over former returns, this confirms the use of the work. In 1885 the boys were shown the Warbles, told their history, and begged to bring what they could find; one pupil alone brought in 250, and in the following year, when he examined his father's and his brother's stock (numbering 114 head of cattle), he found no Warbles, excepting on young cattle which had not been dressed, because they were out in the fields. In 1887 the number of stock examined was 293; number of Warbles found, 104; in 1888, number examined, 515; Warbles found, 311.

These examinations were of cattle belonging to the fathers or relatives of the boys, and while the report of last year shows absolutely only a very moderate presence of attack (even taking cared-for and uncared-for cattle together), at the same time it shows how taking a larger proportion of uncared-for cattle into the detail runs up the average at once.

The boys have now for six years being doing good service in showing how a district *can* be cleared without more trouble than they have a pleasure in giving, and their work has met with the approval of their relatives, and of the Haberdashers' Company, to which the Aldersey

Grammar Schools belong ; also the work was considered so satisfactory that an account of it, written by Mr. Bailey to his Grace the Duke of Westminster, was read by the Hon. Cecil Parker before one of the Committees of the Royal Agricultural Society of England in 1887, and recommended for publication. Further, in giving knowledge of common farm insects, the plan adopted by the Head Master (I have pleasure in saying with endeavours to help by myself) has answered so exceedingly well in giving the boys a serviceable knowledge of farm crop insect-pests and their prevention that, as I have before mentioned, the Dominion Entomologist of Canada, Mr. J. Fletcher, wrote over for details of the plan followed. I have ventured to draw attention to this as an example of a real, *practically* successful plan of instruction on one branch of agricultural knowledge, laid on the foundation of the practical observations of the students to start with.

During 1889 the British observations on Warble-attack bore good fruit beyond their special service in this country, by suggesting investigation in the United States of America relatively to damage caused there also by Warble-maggot, of which I append some notes, as the two countries are mutually interested in amount of prevalence and methods used for prevention of this infestation, which is easily transmissible in shipped cattle. Circulars were sent by the Proprietors of the 'Farmers' Review,' of Chicago, under the superintendence of their Editor, Mr. A. S. Alexander (see also p. 111), to those interested in the subject over (as will be seen below) an enormous area of stock-producing country, and in reply much information was forwarded. Much of this was valuable, some not so, but when sifted and arranged the reports are well worth attention. These will be found at length in the numbers of the 'Farmers' Review' noted below,* and an abstract of these reports was published in the U.S.A. Department of Agriculture Bulletin, entitled 'Insect Life,' for November, 1889.

The following extract from this gives percentage of cattle attacked, and loss on hides in the more especially cattle-rearing States; and when it is borne in mind that the collective extent of the eight States which are noticed as specially infested amounts to about 422,500 square miles, the importance of the loss speaks for itself.

"A host of letters from farmers and stock-men were published . . . Reports were also received from professors of agriculture, entomologists, and veterinarians, which give, as did also those of farmers and stock-raisers, valuable data concerning its abundance in various States, the loss in value to hides, effect on quantity and quality of beef and milk, and also the effect of the attacks on the animals themselves.

* See the 'Farmers' Review,' 134, Van Buren Street, Chicago, Illinois, U.S.A. Nos. for July 17, 24, 31; Aug. 7 and 14.

“ From the reports received, the approximate percentage of grubby cattle and the average loss on grubby hides for the principal stock-raising States of the Mississippi Valley have been estimated as follows (August 7th, 1889):—

“ Illinois.—Seventy-three per cent. of the cattle marketed in the grubby season are infested with grubs. The average loss on a grubby hide is one-third.

“ Iowa.—Seventy-one per cent. of the cattle in the majority of counties are grubby in the season specified. Loss on grubby hides, one-third.

“ Indiana.—Forty-eight per cent. of the cattle grubby. Loss on hides, one-third.

“ Wisconsin.—Thirty-three per cent. of cattle grubby. Loss on hides, one-third.

“ Ohio.—Fifty-six per cent. of cattle grubby. Loss on hides, one-third.

“ Missouri.—Fifty-seven per cent. of cattle grubby. Loss on hides, one-third.

“ Kansas.—Sixty per cent. of cattle grubby. Loss on hides, one-third.

“ Kentucky.—Fifty-seven per cent. of cattle grubby. Loss on hides, one-third.

“ In Minnesota and Dakota, grubs are practically unknown among cattle.

“ In Nebraska, they are not very bad where found; twelve counties report an average of forty per cent. The rest heard from are free of the pest. Grubby hides are ‘docked’ one-third of their value.

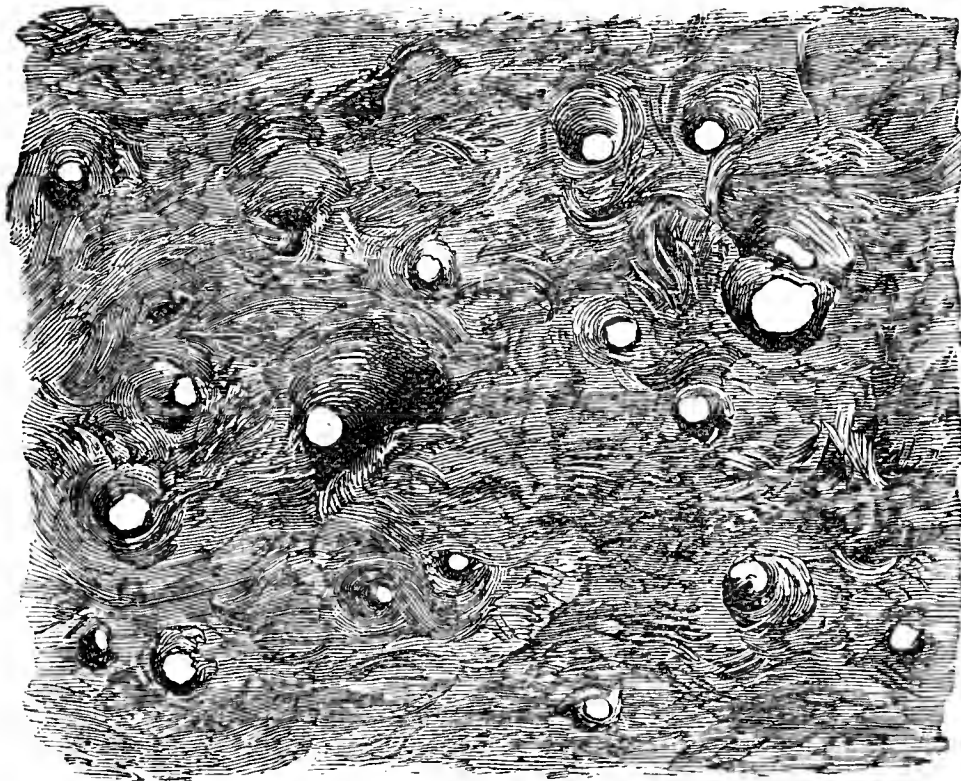
“ In Michigan, sixty-one per cent. of the cattle are infested with grubs in the southern and middle counties. In the northern counties they are unknown, or very scarce. Grubby hides sell for one-third less than sound ones.

“ The amount of this loss can be better appreciated, perhaps, by reproducing in condensed form the approximate estimate of the loss on the hides of cattle received at the Union Stock-yards of Chicago during the grubby season, which includes the months from January to June. Using the reports by States above given as a basis, it is estimated that fifty per cent. of the cattle received are grubby. The average value of a hide is put at 3.90 dollars; and while, from the report referred to, one-third value is the usual deduction for grubby hides in this estimate, but 1 dollar is deducted, or less than one-third. The number of cattle received in 1889 for the six months indicated was 1,335,026, giving a loss on the fifty per cent. of grubby animals, 667,513 dollars. When to this is added the loss from depreciated value and lessened quantity of the beef, the amount for each infested animal

is put at 5 dollars, indicating a total loss on these animals from the attack of the Fly of 3,337,565 dollars."*

As it is of a good deal of interest to be able in some degree to compare the proportion of Warble-presence in infested cattle, and also estimates of rate of money-loss thereby in countries which (as in the present case) suffer connectedly by reason of cattle-traffic from this cause, I add the following abstract of the information which was placed in my hands in 1888, and published in detail with the names of the contributors to whom I was indebted for it in my Annual Report on Injurious Insects for that year. The abstract of this being made with all possible care for my official report as Entomologist to the Royal Agricultural Society of England, I give this with acknowledgment of it being a re-publication:—

“On March 5th, 1889, I submitted the following abstract of information with which I had been favoured in replies to my many enquiries regarding amount of money-loss on hides from Warble-injury (during one year, or during the Warble-season) from several of the chief hide market companies or inspection societies—namely, from Aberdeen, Bristol, Glasgow, Leeds, Liverpool, Newcastle-on-Tyne, Nottingham, Sheffield, &c.



Portion of inside of tanned warbled hide.

“Quoting generally from these,—as I cannot give full details in the space now allowable,—the number of hides passing through these markets respectively are from about 30,000 and upwards to three or four times that number in the year—in some instances the numbers

* See “Insect Life.” ‘Periodical Bulletin of U.S.A. Department of Agriculture’ for Nov., 1889 (vol. ii., No. 5, pp. 156, 157). Washington, Government Printing Office.

exceed 100,000 in the year, and in two instances amounted respectively to about 130,000 per year, and to near on 150,000.

“At one market, where 30,000 were sold in one year, one-third of these—that is, 10,000—hides were warbled; the reduction in value (estimated at an average of 3s. per hide) giving a total loss of £1500—this estimate being given as under rather than over the mark.

“The estimates of loss per hide at the markets vary from about 2s. 6d. to 5s., or sometimes over that sum per warbled hide, and the average weight of hide from which the calculations, or estimates, are made is (where mentioned) about 65 lb.

“The exact proportion of warbled hides is difficult to ascertain, excepting at markets where hides so injured are classed by themselves, but these are given in some cases, and by calculation or estimate the loss at various of the above markets on warbled hides runs in the year reported (or during the four or five months specially known as the Warble months) to sums of respectively £1400; £1500 to £2000; £1800; £2800; and at one of the chief hide centres, where there is careful attention paid to inspection, the loss in the year reported was £15,000. In the return from one town where the amount of cattle slaughtered per week is 700, the proportion of warbled hides during summer and autumn is fully one-third, and the average loss on these is calculated at not less than 5s. per hide.”*

With regard to direct loss in value of the carcase of the animal by beef being what is called “licked.” — In some able observations with which I have lately been favoured by Mr. John Child, Managing Secretary of the Leeds and District Hide, &c., Company, as to details requisite for forming estimate of our British loss in the aggregate from Warble-attack, he mentions:—“The greatest loss on the worst carcasses of beef I ever saw, taking a number together, would not be less than £1 per carcase, or 6d. per stone; of course there are some exceptional cases worse than these, but they are rare—in fact so rare that they should not come within your calculations.”

“I think I am right in saying that the depreciation in the value of licked carcasses of beef are from 6d. per stone down to 1d. per stone, and as the highest figure named comes in fewest number, the average figure for reduction in value should not be taken at more than 2d. per stone. Take the average weight of cattle affected by ‘lick’ and ‘Warble’ at forty stone, we have thus a loss on the carcase of 6s. 8d.”—J. C.

This estimate of our scale of loss or lessened value on this one item appears to run lower than that in America. The above estimate at 1d. to 6d. per stone equalling 3s. 4d. to 20s. per carcase at average

* From Annual Report for 1889 of Consulting Entomologist. Part 1 of New Series of ‘Journal of Royal Agricultural Society of England,’ March, 1890.

weight given, runs a good deal lower than the Chicago estimate of 2 dollars to 5 dollars per carcase, that is, 8s. to 20s. of our money. Our highest estimate is considered to occur so rarely comparatively, that our average loss as calculated above is 6s. 8d., not quite up to the lowest sum noted from Chicago.

I have entered on the above items of trans-Atlantic investigations partly because I believe I may say that it was the widespread progress of the work in our country which roused attention to the need of investigation over the far wider area infested in the American Continent, and also because the returns sent in there, strengthened as they are by the U.S.A. Department of Agriculture having turned its attention by its own investigations and publications to the importance of the subject, corroborate the views of all here who are pushing on the work of prevention.

In the first years of our British investigations, and successively in each season, the reports of those personally interested in the welfare of their cattle, and in gaining paying returns from them confirmed (until now it has become useless to repeat the reports every year) the ease with which this unnecessary and wasteful attack could be got under with very little trouble and very little expense.

Next, in 1888 many of our hide- and cattle-dealing firms came forward, and placed in my hands reports of losses running as high as over £16,000 in one year from damage to hides; in my 'Twelfth Report on Injurious Insects' these returns, with the well-known names of great firms and companies at Aberdeen, Newcastle-on-Tyne, Glasgow, Manchester, Leeds, Liverpool, &c., speak for themselves as to the importance of this branch of loss (see abstract, pp. 121, 122).

Last year, 1889, in obedience to the wish strongly expressed for definite information as to the precise nature of the injury caused to the carcase of the animal by much Warble-presence, commonly known as licked beef or jelly, I did my best, through the kind help given me, to ascertain the bearing of this part of the subject. The results are given at pages 104-112, and the leaflet on 'Licked Beef and Jelly,' in which these are embodied shortly, with full illustration, was received with so much interest that the first ten thousand were distributed in a few weeks. Mr. Edward W. Darby, Secretary of the Butchers' Association, Leeds, and Mr. W. H. Hill, Vice-President of the Sheffield Butchers' Association, especially aided in the distribution, and I was favoured with notifications of approval of the work from leading men in the business, and from Butchers' Associations in various parts of the country, and especially (through their Secretaries) from those of Leeds and Liverpool.

Also, copies of the above-mentioned leaflet were by request placed in many of our Agricultural and Veterinary Colleges, and, whilst

mentioning the good reception given to the information (placed in my hands for public use), it appears to me that this is the long-wanted point by which we can bring home to those whom no other argument will touch, the really *absolute* and *demonstrable* injury to their animals, and *loss to themselves* from allowing their cattle to suffer from maggots in the back until their condition is lowered at a rate estimable in regular trade dealings at so much a stone.

The aggregate of the loss is, as has been shown, to be reckoned by millions of pounds, but as noted before :—Every one of those warbled hides is a sign of so much out of the farmer's pocket for the food he spent in feeding grubs in his cattle's backs, which should have gone to form meat and milk, instead of being wasted in foul maggot-sores; and the quantities of hides of dead beasts brought in with their backs "in a mass of jelly," show there IS loss going *on to an extent* that no farmer *would* allow to go on if he did but know the cause, and the easy cure.

There is no need now, as there was six years ago, to seek for the history of the Warble-attack, or for sure method of *prevention or remedy*; we know these well now from the treatment widely approved throughout the country by our leading cattle-owners and farmers, and can point to the cattle in many a district and farm being delivered by a very little care from this one at least of their troubles. But, beyond this, there is the number to be considered of those who do not care to think, nor to take trouble, and had rather go on telling old wives' tales about "health-bumps" than free the cattle's backs from maggots.

Our hope for progress lies (for one thing) in all who are interested helping to spread *plain* information, and we are certainly doing well in this respect, as upwards of a hundred thousand of the Warble leaflet, of which a copy is added at the end of this Report, have been distributed, and copies of this in the North and South Welsh dialects have also been distributed in the Principality. But we could also do much good by gaining spread of instruction in schools in agricultural districts. A very little teaching—ten minutes' instruction to the boys, with specimens of the maggot shown at the same time—would be enough for them; they would see the state of the case, and in all probability help with the greatest willingness; and in the very near future we should by this means gain farm-helpers and cattle-lads who would give no ear to the sort of bumps out of which with their own hands they had squeezed maggots and filth being called health-bumps; and for their elders, as at Bunbury, the improved state of the cattle would soon bring thorough approval of the work.

For my own part in this, I am only happy to continue to forward to all applicants copies for distribution of my four-page Warble-leaflet, of which a sample is appended, or that on Licked Beef and Jelly, and its results; and also to offer any information in my power to any applicant.

APPENDIX.

SHOT-BORER BEETLES. *Xyleborus dispar*, Fab.

(Continued from p. 98.)

AFTER the preceding paper on the Shot-borer Beetle was in type, I had the opportunity of studying the very serviceable information given by Herr W. Eichhoff, Imp. High Forester, in Muhlhausen, Alsace, from his own personal observations in his work on 'European Bark-beetles.' From this I quote below some passages of very practical use regarding the locality and food-material of the maggots, and also some practicable methods of prevention, which can be used on a broad scale with little expense, and which (as the plan has been found to answer excellently in checking the attacks of other wood- or bark-beetles), it might be hoped, would do equal good in the case of Shot-borer attack.

In the following observation it will be seen that Herr Eichhoff confirms the observations of those who consider the maggots feed in the "mother-galleries," that is, the borings made by the female beetle, and he also notes the food of these maggots to be partly-coagulated sap, and partly a fungus or mould growing in the damp borings:—

"The *dispar* only uses the wood which is still fresh, and full of sap for the brood; this sap soaks ('sweats') so constantly out of the walls of the breeding-galleries that presently this thickens into white-of-egg-like coagulations (called by Schmidtberger 'Ambrosia'); and from these the coatings of fungi which have been so often mentioned develop, whereby after a time the surface of the circular galleries becomes stained black. These coagulations, and occasionally the fungoid growths, serve exclusively for the nourishment of the young larvæ; that afterwards these feed on the solid wood (as has been accepted very generally up to the present time) has probably never been observed as a fact by any one."—W. E., 'Europ. Borkenkafer,' p. 272.

To any one who has carefully dissected out the workings of this beetle, it is unaccountable how the belief of the maggots of this species feeding on the wood itself could have arisen. In all the British specimens which I have had opportunity of examining myself the tunnels were as described first by Schmidberger, that is, there was a total absence of side- or maggot-galleries; and in all the mother-galleries, which I have now once again carefully examined with a view to ascertaining whether there were the inequalities of surface quite inseparable from as many maggots as the galleries could hold feeding

therein, I could not find *any* of these; the galleries ran on smoothly, and were of an even surface and width.

As the maggot-season was past when I received the British specimens, and examined the state of the contents of the galleries, what was *then* to be found there necessarily was no proof of what the maggots *had* fed on, but there was some amount of the fungus-mycelium certainly present.

Herr Eichhoff mentions (p. 274) that, "like almost all bark-beetles, the *dispar* has annually two seasons of appearance, and correspondingly two generations," but this refers to German observations; we do not know as yet how this may be in our somewhat different climate. He also draws attention to the great number of males which may occasionally be found collected together, which is a point of much interest, for the male beetle has been considered to be so exceedingly rare that when I had, in the course of dissecting out the beetle-tunnels in the middle of the winter, found small parties of them (the male *dispar*), not unfrequently collected by themselves, I was told by the Rev. Canon W. Fowler (well known for his knowledge of the Coleoptera) that large sums had been given for a single specimen, even, he believes, amounting to twenty shillings a-piece at no very distant date previously.

*The very important point, however, of the information which we gain from Herr Eichhoff's treatise is that there really are practicable methods of prevention, or at least of lessening amount of presence, and continued spread of this thorough pest. It will be seen that these are of precisely the same nature as the precautions regarding Pine-weevil and Pine-beetle attack, which have now been in regular and approved use in Pine-woods and plantations by foresters for many years.**

The principle of this prevention lies in the removal of the fallen or injured wood, which, by reason of the sluggish movement of the sap, is particularly acceptable to the beetles for breeding purposes, and also in placing poles ("trap-wood") to attract the beetles, and then destroying the infested poles.

Herr Eichhoff notes that, even though *dispar* is undoubtedly not so badly destructive in reality as might be inferred from the repeated statements "that it only attacks and breeds in sound wood," yet, going still further, he thinks from his own observations that it is not worse than many others; and he remarks:—"As I have repeatedly said, it prefers to breed in stumps of felled Oaks and Beeches, and in fallen trees, and so long as it has these it spares the effective healthy material."—W. E.

* These have been entered on at length in previous Reports, and some further observations are given in this present Report (pp. 88—91), with a special observation (at top of p. 91) of attack of Pine Weevil occurring where the preventive measures had been omitted.

He further notes:—"For preventive measures, what is needed first of all is regular grubbing and removal of Oak and Beech, &c., stumps* early, by the beginning of the warm season; and next at the time of the summer felling to remove and burn all infested wood."

But for extirpation the use of trap-wood is particularly recommended. For this trapping material, Oak-poles with one end buried or driven into the ground are considered the most suitable, as they keep fresh longer. These are to be set from March to August and September, and periodically looked to, that is, about every three or four weeks, as the beetles prefer quite fresh wood for breeding purposes; but where it is at all open to doubt that attack has settled on the trap-poles, they should be removed at the latest in six weeks after placing.

The following warning, which I give in Herr Eichhoff's own words, is also worth attention:—"Orchard-growers and gardeners, especially such as live near wood-stores and timber-yards in which great amounts of wood are kept, would do well to protect themselves against injury to their fruit-trees from attack which may come out of the infested material, even though it may be necessary for them first to purchase it."†

The observations about this pest being found in fellings are well worth the best consideration of all suffering from its ravages. It is very likely that a watch on what is going forward would discover it in pieces of wood with bark on, slabs, &c., as is the case with other infestation in Pine-plantations; and although in every instance where I have had the opportunity of examination the affected trees appeared perfectly healthy, it would be worth while noticing whether attack appears to take place to a greater extent *on young trees recently moved* than on those which have remained in position. Some kinds of beetles, like the "Ash-bark Beetles," which especially attack recently-felled trunks, have instinctive knowledge of the condition best suitable for egg-laying, and will select stems where the sap is not in the full flow of *vigorous* life, which would be likely rather to stifle the maggots than to feed them, or moisten the wood for their brood in their tunnels.

It is not at all unlikely that following up the above principles might show us what trees were most liable to attack, and therefore needing protection at beetle-time, as well as what wood-rubbish or loppings might be serving as a nursery for the pest.

* This of course includes all kinds of stumps which are infested; in our own case Plum-tree stumps or fallen stems would especially need looking after.—E. A. O.

† The above information and extracts are taken from 'Die Europäischen Borkenkäfer,' von W. Eichhoff, Kaiserl. Oberförster in Mulhausen i. Elsass. Berlin, 1881.

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* Potato Eelworm.—The careful researches of Prof. Geo. F. Atkinson, Biologist of the Agricultural Experiment Station, Auburn, Alabama, U.S.A., published in the "Science Contributions" of that station for Dec., 1889, and recently received in England, have shown one species of Nematode or Eelworm which is injurious to Potatoes in America to be the *Heterodera radicicola* (Greef.), Mull. Investigations as to the kinds of Eelworms to be found infesting Potato-tubers in Britain in the manner described in note, p. 8, or causing gall-swellings on the roots, would be serviceably interesting.

NOTES

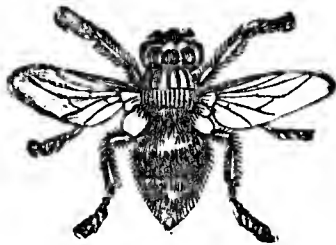
ON

OX WARBLE FLY, OR BOT FLY,

Hypoderma Bovis, De Geer.



2



1



3

1, OX WARBLE FLY; 2, maggot; 3, chrysalis.

THE OX WARBLE FLY, OR BOT FLY, is a two-winged fly, upwards of half-an-inch in length, so banded and marked with differently-coloured hair as to be not unlike a Humble Bee. The face is yellowish; the body between the wings yellowish before and black behind: and the abdomen whitish at the base, black in the middle, and orange at the tip. The head is large; the wings brown; and the legs black or pitchy, with lighter feet.

The female is furnished with a long egg-laying tube; but whether she inserts her eggs into the hide or lays them on it has not been made out with certainty.

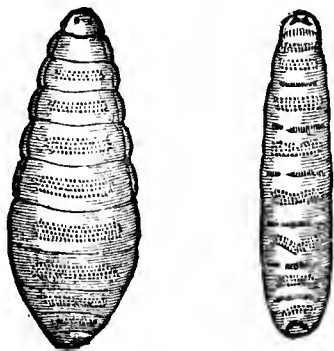
Egg-laying takes place *during the summer*; it may begin in the month of May, but the time varies with the weather, and with the cattle being on low land or hill pastures, and other circumstances. The egg is oval and white, with a small brownish lump at one end.

When full-grown the Warble-maggot is the shape figured above.

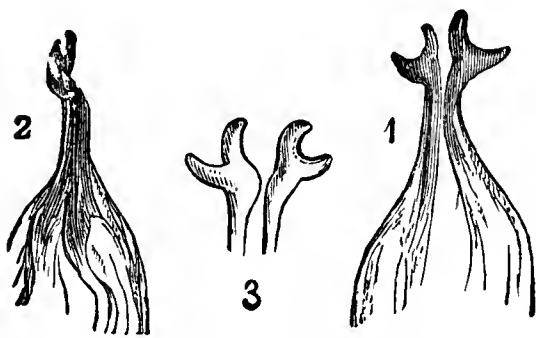
The mischief may first be found on the flesh side of the hide early in the winter. Specimens received from Messrs. Hatton, Hereford, on November 13th, showed the first appearance as small swellings bluish in colour, as if half a large shot was under the skin, and much inflamed round. The maggots were very minute and blood-colour, and lying free (not in a cell) with a fine channel down through the hide to where they lay.

The open Warble was first found towards the end of January, and by the end of February open Warbles were noticeable in many places, and the maggot was now white (not being feeding in bloody matter), worm-like, and with strong mouth-forks; in its next stage it was club-shaped, and had a power of inflating itself by drawing

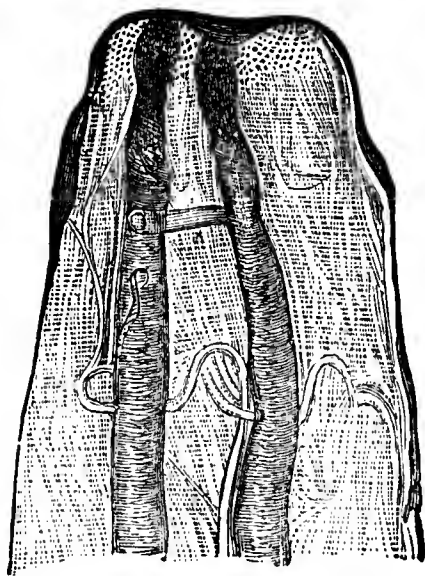
in fluid until it was almost as hard and transparent as ice, and, lying small end uppermost, thus kept pressing the opening through the hide larger. In its next stage it gained its well-known shape, with a thicker and more prickly skin, the Warble-cell at the same time gaining its membranous coating.



Maggots.
Club-shaped. Worm-like.
Magnified.



Mouth-forks of young maggot,
much magnified.



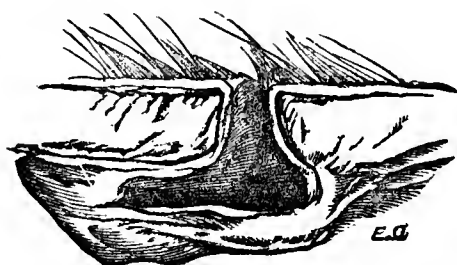
Breathing-tubes of maggot,
magnified.

The maggot can move up and down, but commonly has its brownish-tipped tail at the opening, and it draws in air through breathing-pores in these brown-black tips or spiracles. The mouth-end is down below, feeding in the ulcerated matter caused by irritation from perpetual suction of the mouth parts. The maggot cannot protect itself from the effect of applications, therefore anything put on the opening where the breathing tips show will choke the breathing apparatus, or run down into the hole and poison the maggot. The earlier this is done in the season the better it will be for the animal, and the less difficulty there will be in the Warble-holes healing.

Whilst the maggots are in the Warbles, though a skin-like membrane forms round the surface of the perforations (see figure, page 3), they cannot heal up because the maggot lies within; and when the Warble-grub has *fallen out*, though the hole contracts, the surfaces, being already covered with a film of tissue, are slow to unite; and, as may be seen in warbled hides, union is often prevented by this skin-like film shelling off, and laying with dried matter in the perforation. On

the under side of the hide, though the *surface may not* be broken, yet the subcutaneous tissues are often left as a mere film of no strength, which injures the surface of the leather.

When the maggot is full-grown it is about an inch long and dark grey; it presses itself out of the opening *tail foremost*, and falls to the ground, where it finds some shelter, either in the ground or under a stone or clod, where it changes to a chrysalis. The chrysalis is dark brown or black, much like the maggot in shape, only flatter on one side; and from this brown husk the Warble Fly comes out in three or four weeks, but this length of time is *increased by cold weather*.



Section of Warble, after soaking in water.

With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the Warble-maggot easily and cheaply, when the Warble has "ripened"—that is, opened so far that the black end of the tail is visible. *Then* it may be destroyed cheaply and quickly. From special observations, taken during the last three years, it has been found that where the Warble-maggots have been destroyed before they drop from the cattle, there is little if any summer attack of Warble-flies. Consequently the cattle can rest in peace, and, as there is very little egg-laying on them, there are scarcely any Warbles in the following spring.

Squeezing out the maggots is a sure method of getting rid of them, but they may be destroyed easily and without risk by dressing the Warble with a little of McDougall's smear or dip, or by a little cart-grease and sulphur, applied well on the opening of the Warble. Mercurial ointment answers, if carefully used—that is, in very small quantity, and only applied *once* as a *small* touch on the Warble; but where there is any risk of careless application it should not be used. *Any* thick greasy matter that will choke the breathing-pores of the maggot, or poison it by running down into the cell in which it lies and feeds, will answer well; and lard or rancid butter mixed with a little sulphur has also been found to answer. Tar answers if carefully placed, so as to be absolutely on the hole into the Warble. Bought cattle are often badly infested, and need attention.

To prevent fly attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a-week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce.

A mixture of spirit of tar, linseed oil, sulphur, and carbolic acid, has also been found useful; and anything of a tarry nature is useful, as sheep-salve (or bad butter and tar mixed with sulphur), or Stockholm or green tar, rubbed on the top of the cows' backs between the top of the shoulder-blade and loins. Washes of

a strong pickling brine, applied two or three times during the season, are very useful. Paraffin and kerosine are useful for a time, but the smell goes off before very long.

Where cattle are suffering badly from Warbles, so that the health is clearly affected, and the animal wasting, the use of the well-known old "black oils" has been found to do much good.

Mr. Hy. Thompson, M.R.C.V.S., of Aspatria, Cumberland, gives the following recipe used for a bad case:—"Turpentine, $1\frac{1}{2}$ oz.; sulphuric acid, 1 drachm (here a chemical action sets in and must be done with caution). To this I added 10 oz. raw linseed oil, and rubbed the cow's back once a-day with the mixture. . . . In a fortnight the back was cleaned and all the maggots destroyed."

There are many other points that bear on prevention, of which one is--noting that Warble Flies are *most active in heat and sunshine*, and appear *not to pursue cattle over water*; consequently allowing the cattle the power of sheltering themselves, and access to shallow pools, is desirable. Likewise with regard to pastures, or standing-ground of infested cattle, it is matter of course that where the maggots *have fallen from their backs the Flies will shortly appear to start new attacks*.

Warble attack is one of the few in which each owner benefits surely by his own work.

The attack of Warbles is now grown to be one causing enormous annual national loss, estimated by practical men at sums from *two millions to seven millions pounds sterling per annum*, at the least. There is no sort of reason why we should suffer it to go on; and the reports sent in from cattle owners in Great Britain and Ireland during the last three years show the ease with which the attack may be checked, and the great consequent gain to owners. Any applications to myself on the subject will receive immediate and most careful attention, and any information would be gladly received.

ELEANOR A. ORMEROD,

*Consulting Entomologist
to the Royal Agricultural Society.*

TORRINGTON HOUSE, ST. ALBANS,
May, 1888.

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