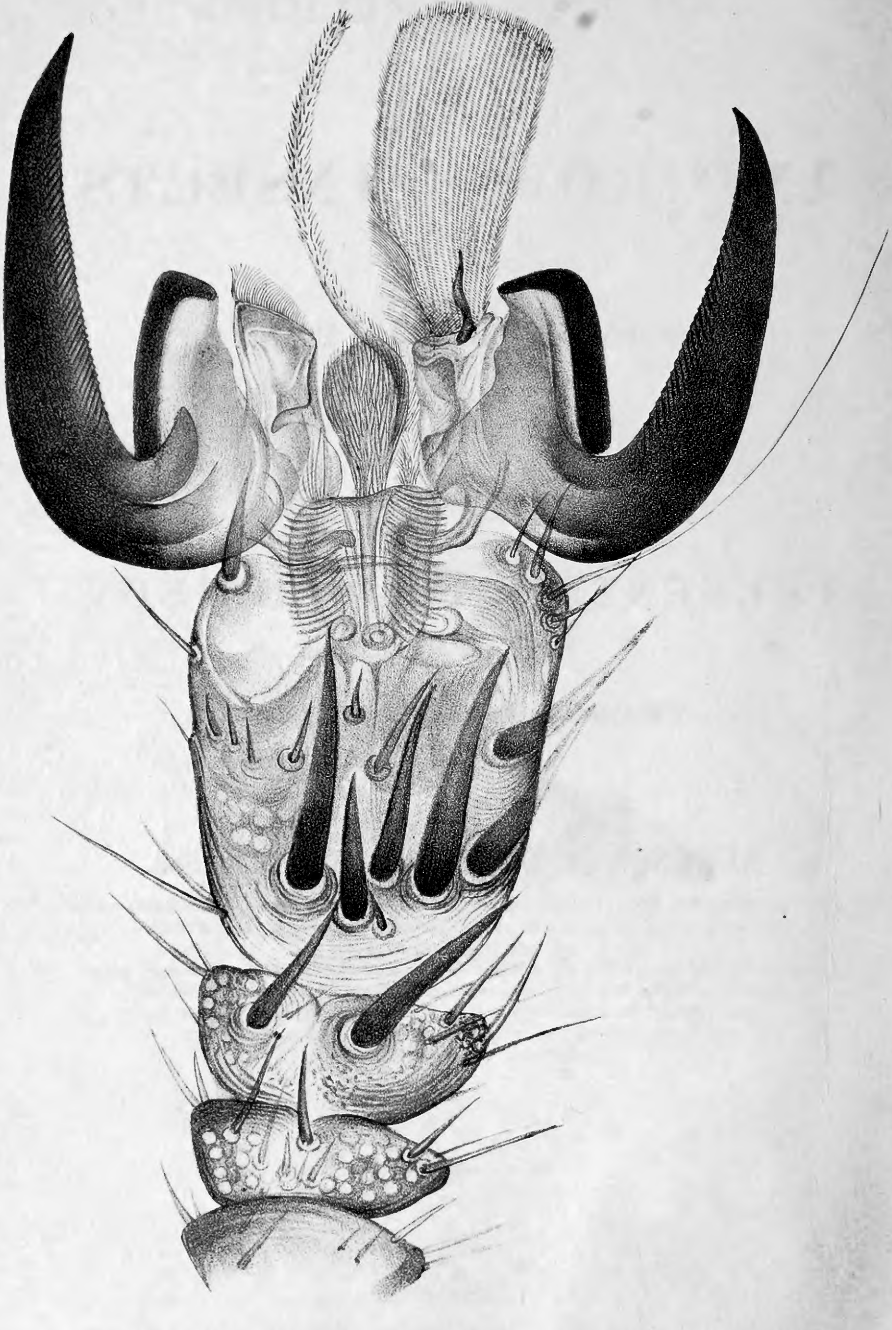

Horace Knight ad nat. del.

West Newman lith

Foot of Forest Fly (Hippobosca equina *Linn.*)

Seen from above greatly magnified.

REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1898,

WITH METHODS OF

PREVENTION AND REMEDY.

TWENTY-SECOND REPORT.

BY

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PREFACE.

During the past season there has been more than usual variety in the amount and also in the kinds of insect infestations. In a few instances these have been *more* than usually numerous, in some *less* observed than is ordinarily the case; a few species that are very rarely noticed were reported, and also one or two observations of extension of locality of somewhat serious infestations have been given.

Amongst attacks that were unusually present, *Aphides*, or "Blight," were especially named; and later in the year widespread loss was caused in many places to Cabbage growers, and also in private gardens, by the visitation of caterpillars of different species of Cabbage butterflies (*Pieris*), which appeared almost in flocks, and set on foot little short of complete devastation. Amongst fruit attacks, that of the Pear Gnat Midge (*Diplosis pyrivora*), causing destruction of the young forming Pears, was much more prevalent than in any year since 1883, when its presence was first recorded in this country.

Amongst infestations which have been very little noticed previously is that of the Pith Moth (*Laverna atra*), of which the maggot destroys entire bunches of Apple blossom-buds by tunnelling up the shoot immediately beneath the cluster. This attack has probably long been present, but not distinguished from another very similar in its effects, and it being brought forward may be certainly expected to enable orchard growers to get rid of it to a great extent. The "Ground Beetles" (*Pterostichus* and other allied kinds, which have been so injurious for the last few years to Strawberry fruit, and for the ravages of which simple remedial measures have now been reported, see pp. 124–126) again appeared as a field crop pest to Mangold roots; also the "Pigmy Mangold Beetle" (*Atomaria linearis*), an insect almost too small to be noticed excepting in the collections of hundreds or thousands in which it attacks the germinating or young Mangolds, again showed itself. Potato haulm has for some years been occasionally reported from various localities as being seriously injured by the tunnelling of a moth caterpillar for many inches up the stem, and from last season's observations this appears to be the work of *Hydrœcia micacea;* but two species may be present, and as one of these would be very easily kept in check, but not the other, more information is needed. Hops in a few places were much injured by the Clay-coloured Weevil

(*Otiorhynchus picipes*), not previously reported as injurious to this crop, although causing severe loss in fruit grounds.

Amongst timber infestations, notes were sent for the first time, of damage caused by two species of a small timber-boring beetle (*Trypodendron*) by tunnelling into the outside wood of, respectively, felled Pine and of deciduous trees, and more information regarding the attack would be very desirable.

The observation of presence of Horse Forest Fly, *Hippobosca equina* (which was formerly supposed to be almost entirely confined to the neighbourhood of the New Forest), as occurring to an extent to cause serious inconvenience in a district of Glamorganshire, and the adjacent part of Brecknockshire, is of considerable practical interest. I have also amongst the reports mentioned damage to cattle *popularly* attributed in some districts in Ireland to what is called the "Murrain Worm" (see p. 72), as, though the caterpillar is perfectly harmless, the illness appears to be very real, and it may arise from eating poisonous water-plants, growing in the same localities as those on which this Sphinx moth caterpillar feeds.

Few inquiries have been sent as to damage to corn crops caused by the ordinary stem or grain insects, although the general root pests of Wireworm, and Daddy Longlegs grubs, were notably present; and Stem Eelworm, causing Tulip-root in Oats, was present, and also did widespread and serious mischief in late winter and early spring by causing Stem-sickness in Clover.

"Surface caterpillars," which are usually very troublesome at root crops, and leafage caterpillars, which in a hot dry May are sometimes a complete devastation to orchard leafage, were little inquired about.

The following list gives the names of most of the attacks regarding which I received applications, classed for convenience of reference under headings of the names of the Orders to which they belong:—

Beetles (*Coleoptera*).

Asparagus Beetle, *Crioceris asparagi*	Asparagus shoots.
Bacon or Larder Beetle, *Dermestes lardarius*	Bacon, &c.
Bone and Leather Beetle, *Dermestes vulpinus*	Bones, wood, &c.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and roots.
,, Rose, *Phyllopertha horticola*	Flowers, leafage, and roots.
Death-watch Beetles, Paste, *Anobium paniceum* . . .	Stores, seeds, &c.
,, ,, Wood (striped), *Anobium striatum*	Woodwork and furniture.
,, ,, ,, (tessellated) ,, *tessellatum*	,, ,, ,,
Grain Beetle (Saw-toothed), *Silvanus surinamensis* . .	Corn and stores.
Ground Beetles, *Calathus cisteloides*	Strawberry fruit.
,, ,, *Harpalus ruficornis*	Strawberry fruit & Mangold roots.
,, ,, *Pterostichus madidus*	,, ,, ,,
,, ,, ,, *vulgaris*	,, ,, ,,
Lady-bird Beetle, *Coccinella septempunctata* (beneficial).	Aphides.
Mangold Beetle (Pigmy), *Atomaria linearis*	Young Mangolds.
Mustard Beetle, *Phædon betulæ*	Mustard.
Oak-borer, *Trypodendron domesticum*	Wood of deciduous trees.
Pine-borer (Striped), *Trypodendron lineatum*	Wood of conifers.
Pine Timberman, *Astynomus ædilis*	Pine logs.
Weevils, Apple, Oblong-leaf, *Phyllobius oblongus* . .	Orchard leafage.

Weevils, Apple-blossom, *Anthonomus pomorum*	Apple flower-buds.
,, Granary, *Calandra (Sitophilus) granaria*	Stored grain.
,, Pea and Clover, *Sitones* (of various species)	Leafage.
,, Raspberry, Clay-coloured, *Otiorhynchus picipes*	Orchard, Hops, &c.
,, Red-legged, *Otiorhynchus tenebricosus*	Pear, &c.
,, Vine, *Otiorhynchus sulcatus*	Vine, &c.
,, Turnip-seed, *Ceutorhynchus assimilis*	Turnip seed-pods.
Wireworms (larvæ of different species of Elaters)	Roots of Grass and crops.

Butterflies and Moths (*Lepidoptera*).

Antler Moth, *Charæas graminis*	Grass roots.
Buff-tip Moth, *Pygæra bucephala*	Apple leaves.
Cabbage Butterflies (*Pieris* of various species)	Cabbage.
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Eyed Hawk Moth, *Smerinthus ocellatus*	Apple leaves.
Goat Moth, *Cossus ligniperda*	Live wood.
Lappet Moth, *Gastopacha quercifolia*	Apple leaves.
Magpie Moth, *Abraxas grossulariata*	Gooseberry & Currant leaves.
"Murrain Worm," Elephant Hawk Moth, *Chærocampa elpenor* *	Plants near water.
Pith Moth, *Laverna atra*	Apple shoots.
Pale Tussock Moth, *Dasychira pudibunda*	Hop (also Apple) leaves.
Potato-stem Borer, *Hydrœcia micacea*	Potato stems.
Privet Hawk Moth, *Sphinx ligustri*	Privet leaves.
Surface Caterpillars (*Agrotis* of various species)	Turnips, &c.
Winter Moth, *Cheimatobia brumata*	Orchard leafage.
Wood Leopard Moth, *Zeuzera æsculi*	Wood of branches, Pear, &c.

Two-winged Flies (*Diptera*).

Cabbage & Turnip-seed Gnat Midge, *Ceutorhynchus assimilis*	Turnip seed.
Daddy Longlegs, *Tipula* (*oleracea*, &c.)	Roots of Grass.
Great Ox Gad Fly, *Tabanus bovinus*	Cattle.
Grouse Fly, *Ornithomyia avicularia*	Grouse.
Hawthorn Gnat Midge, *Cecidomyia cratægi*	Ends of Hawthorn shoots.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Horse Forest Fly, *Hippobosca equina*	Cattle and Horses.
Ox Warble Fly, *Hypoderma bovis*	Hides of Cattle.
Pear Gnat Midge, *Diplosis pyrivora*	Pear blossom-buds.
Sheep's Nostril Fly, *Œstrus ovis*	Nostrils of sheep.

Fleas (*Aphaniptera* = *Siphonaptera*).

House Flea, *Pulex irritans*	Man.

Sawflies, Bees, &c. (*Hymenoptera*).

Hornet, *Vespa crabra*	Fruit, &c.
Leaf-cutter Bee (larvæ), *Megachile* (? *centuncularis*)	Leaves.
Sirex (Giant), *Sirex gigas*	Pine timber.
"Slugworms," larvæ of Pear Sawfly, *Eriocampa limacina*	Pear and Cherry leaves.
Wasp, *Vespa germanica*	Fruit, meat, &c.

Aphides, Scale Insects, &c. (*Homoptera*).

Aphis, Apple, *Aphis mali*	Leaves.
,, Larch, *Chermes laricis*	Young shoots and leaves.
,, Turnip,	Turnip leaves.
,, Woolly Apple, American Blight, *Schizoneura lanigera*	Apple bark.
,, ,, Pine, *Schizoneura fuliginosa*	Pine leaves.
Apple Scale, *Mytilaspis pomorum*	Bark.
Currant and Gooseberry Scale, *Leucanium ribis*	Bark.
Suckers, Apple, *Psylla mali*	Stems of flower buds.

* This entry is inserted relatively to a popular belief in Ireland that the larva causes "murrain" to cattle! See pp. 72–75.

Besides the above insect pests, other allied kinds were present as usual; notably the Black Currant Gall Mite (*Phytoptus ribis*), which, from the careful attention which is being devoted to the subject, we hope may presently be brought more under control; the Filbert Gall Mite (*P. avellanæ*) was more than usually present. Eelworm attacks have been alluded to above, and Millepedes, as matter of course, were reported as troublesome, besides other incidental infestations forwarded for identification and information as to remedial measures, but without notes of habits, &c., which are always much to be desired for increase of our knowledge.

The amount of application both regarding insect attacks *at once* requiring attention, and also inquiry correspondence connected with the subject, has so much increased that I have difficulty at times in attending with the promptness which I always wish to do to applicants, and also in carrying on research, both personal and by correspondence with observers of little-known attacks, which is needed to learn their life-histories as occurring in this country. Also much time is taken by attention to inquiries regarding *ordinary* attacks which have been frequently entered on in my foregoing Annual Reports, and I believe are now so generally known both to agriculturists and orchard-growers that reference to them would not convey any new information to my readers.

Therefore, by advice of friends, I this year publish, in addition to my Annual Report, a "General Index" of the whole series, as an assistance in reference to those possessing the set, with a short digest preceding of the main points regarding special observations of our more important insect attacks which have been contributed in the past twenty-two years.

So long as health sufficient for the work is granted me, and I am honoured by being asked to assist, it is only a pleasure to me to endeavour to do my very best, and I hope to continue to publish yearly results, but with a little difference in the plan, so that I may utilize *short notes* of useful means of prevention and remedy sent me, *in a separate section* following the body of the Report, and under a distinctive heading. Thus I hope that we may gather up *all* information sent, but without encumbering the Reports with *repetition of figure and description*, save where necessary. With these slight differences (and all being well) I propose to commence a new issue as a "Second Series."

With regard to assistance in the work, which is increasingly becoming more than can be dealt with by one person, I have much help in secretarial matters from my resident lady secretary, Miss Hartwell; but in much press of application and occasional illness in the past year, I have found great need of a scientific entomological colleague to whom, in order to save delay, I might apply as occasion required to give desired information to applicants, and also who would oblige me by co-operation in extreme cases of minute microscopic investigation.

I have therefore, through the kind courtesy of Mr. Robert Newstead, Fellow of the Entomological Society, Curator of the Grosvenor Museum, Chester, made arrangements with him which, by permitting me to communicate with him if occasion arises, remove my fear of difficulties occurring on the above heads, and give me great satisfaction, as I have long been acquainted with his careful insect investigations, and his great powers of microscopic observation and delineation, for examples of which I may refer to the forthcoming volume on *Coccidæ*, prepared by him for publication in the Ray Society. To the above I may add that any contribution with which I may be favoured by Mr. Newstead will be most fully acknowledged to him in my pages.

Of the figures in the present Report, I beg to acknowledge with thanks those at pp. 127 and 130 as being by permission of Messrs. Blackie & Son, of Glasgow; those at p. 12 and heading of p. 78 I have been permitted the use of from the 'Gardeners' Chronicle' set; the figures of moths at pp. 1 and 72 are from Newman's 'British Moths'; the figure at p. 5 from 'Insects Injurious to Fruit (in Canada),' by Dr. W. Saunders. The other figures, excepting where acknowledgement is given accompanying or in the letterpress, have mostly been drawn expressly for my own publications.

Once again (as in what are now *many* former years) I desire to express my cordial thanks for the encouragement and assistance in my work given me from too many kind helpers and friends for me to express my thanks adequately. But I would wish especially to acknowledge much encouragement from our British agricultural and frequently from the general Press; also the liberal donations of serials bearing on prevention of insect ravage which I am constantly in receipt of from our Colonial Departments, from the Continent, and from the Agricultural Department, Washington, U.S.A., and its many co-operating stations, for all which, and much other kindly assistance, I most heartily thank my kind and helpful friends.

ELEANOR A. ORMEROD, F.E.S.

Torrington House, St. Albans:
March, 1899.

Note.—The General Index is now almost completed, and will be forwarded on publication to colleagues who are customarily recipients of the Annual Reports. It will also be purchasable if desired; see advertisement inside first page of wrapper for particulars.—E. A. O.

List of Injurious Insects, &c., noticed in this Report.

* The two species of *Trypodendron* are placed in sequence for convenience of reference.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

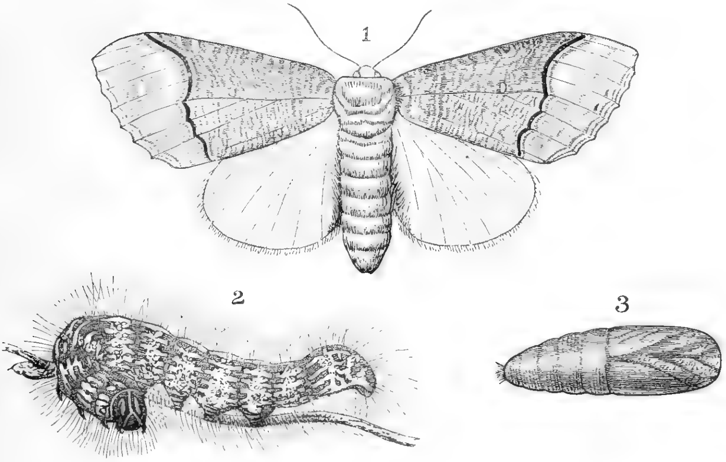
AND

COMMON CROP PESTS

DURING 1898.

APPLE.

Buff-tip Moth. *Pygæra bucephala*, L.



PYGÆRA BUCEPHALA.—1, moth; 2, caterpillar; 3, chrysalis.

THE caterpillars of this fine moth, figured above, are very general feeders, and are recorded as infesting the leafage of the Alder, Birch, Beech, Elm, Hazel, Lime, Oak, Poplar, Willow, &c.; and in October (1887) I had fine specimens sent me which had been taken at Rathdrum, Ireland, on "Evergreen Oak" (*Quercus Ilex*), and which were feeding voraciously on the pieces of Evergreen Oak sent with them. But I am not aware of the infestation having been recorded as often injurious to leafage of orchard trees, and it was not until the past season (1898) that I received inquiries as to the caterpillars doing a good deal of harm, at the localities noted below, to Apple leafage.

On May 10th Prof. F. O. Solomon wrote to me from the Durham College of Science, Newcastle-on-Tyne, as follows:—

"Is the 'Buff-tip' Moth (*Pygæra bucephala*) in the habit of doing much injury to Apple trees? Last summer I found a young Apple tree (just commencing to bear) *entirely cleared of its leaves* by the caterpillars. I collected several of the grubs, and the moths emerged from the chrysalis last, and this, week, so that there is no doubt of the insect. Of course I know the caterpillars devastate Lime and some other trees, but did not know they damaged Apple trees. . . . I got my caterpillars from a young orchard near Dartford, in Kent."—(F. O. S.)

On August 31st I received caterpillars of the same species, *Pygæra bucephala*, from Mr. D. Beckwith, Easingwold, Yorkshire, with a request for information as to their name, and how best to prevent the spread of the infestation.

Mr. Beckwith mentioned that he had found some specimens that day "on an Apple tree of 'Duchess of Oldenburg' variety." They had devoured every leaf on one side of the tree. "I also observed that a small Apple tree—a maiden—planted last year, and consisting of just one straight stem, about twenty-seven inches high, had been entirely stripped of its leaves in like manner, but I could not find any caterpillar about it, and no other trees, as far as I have discovered (although there are over a thousand in the orchard), are affected. . . . It would be a very serious matter for me if they were to spread."—(D. B.)

The complete clearance of the leafage from the trees, or parts of trees, attacked by the hordes of these caterpillars is one of the characteristics of the infestation. On August 19th, 1884, specimens were forwarded me from Llanerch, Llanelly, South Wales, which had been found attacking young Oaks in the nursery, with the remark that they had, when noticed, "entirely stripped two or three young trees of their leaves, and then were clustered together on the twigs in much the same way as the Pine Sawfly caterpillars on Scotch Fir, and were doing their work quite as thoroughly."

On August 27th, 1887, caterpillars were sent me from Ockbrook, Derby, which had been taken from a Broad-leaved Elm, with the observation from the sender that when he saw them first, about twelve o'clock that morning, they were in hundreds on one large branch, and had entirely stripped that one branch of its leaves. On going again in the evening, about six o'clock, only a comparatively small number were observable. (Presumably the caterpillars were leaving the tree to turn to the chrysalis state.—E. A. O.)

The moth is usually from two and a quarter to two and a half inches in expanse of the fore wings, which are of a pearly grey ground colour, inclining to a more purple tint towards the fore edge, and a silvery grey at the base, very near which is a transverse brown line, and a little beyond this is a transverse bar formed of three brown lines. Another brown bar starts near the tip of the wing, and after making a semicircular curve (see figure, p. 1), crosses the wing transversely with a zig-zag line. Between this and the brown bar the wing is marked with many fine-waved transverse lines, and outside the semicircular curve the tip of the wing is occupied by a large ochreous or buff-coloured blotch, whence the moth takes its name of "Buff-tip." The hind wings are yellowish white, somewhat clouded towards the middle. The head is ochreous; the body between the wings with a double brown line on each side and behind, and the abdomen dingy ochreous.

The moths are to be found pairing about the beginning of June. Directly afterwards, the eggs are stated * to be laid, up to as many as thirty to sixty in a patch, mostly on the upper side of a leaf. These are convex and white or greenish above, with a black dot in the middle of the convex portion; beneath they are flat and of a smoky colour.

The caterpillars hatch in about a fortnight, and at first feed together on the upper skin and tissue of the leaf, leaving the veins uninjured. After eight days they moult, and then separate into little companies of six to ten, each party betaking itself to the tip of a leaf, and feeding at the edge in the common caterpillar manner; towards the end of July they are full-fed, and their presence may be known by the mischief they have caused, the various broods having stripped the leafage from the boughs where they have established themselves "as bare as if in the depth of winter."

When hatched, the caterpillars have large shining black heads and narrower yellow bodies, with soft hairs, and a series of black spots, which are most noticeable along the middle of the back. When full-grown, the colour is more varied. The head is still black, but it is covered with minute punctures, and has a yellow mark, like a V reversed on the face; it is covered with fine silky hairs, as is also the body, which is now of a yellow ground colour, marked along the sides with an orange transverse streak about the middle of each segment, and, alternately with these, with an ill-defined and sometimes scarcely observable whitish mark on the segmental division. Nine longitudinal stripes of more or less elongate black blotches run along the back and

* I have not myself had the opportunity of observing the whole life-history, and therefore give (with due acknowledgment) some of the main points recorded by Newman in his detailed account of this species, given in 'British Moths,' pp. 219, 220.

sides, from the third to the twelfth segment inclusive, of which the row down the middle of the back is the broadest and the most observable. The spiracles are black, so also are the claw- and sucker-feet for the most part (unless yellow within). The caterpillar is full-grown in September, when it changes to the pupal state, which is dark brown, punctate, and shining, terminating in two forked processes (see figure, p. 1).

When the time for their change has come, the caterpillars descend the stems of the trees, on the leaves of which they have fed, and crawl actively in any direction that may suit their views, whether over dusty roads, flagged pathways, or anywhere else, till they find a suitable locality for turning to the chrysalis state, under fallen leafage, or in other shelter, or at the surface of the ground, without the protection of any web or cocoon.

I had the opportunity of watching the damage caused by these caterpillars on roadside trees whilst for some years I was resident at Spring Grove, near Isleworth; but, not being able to give their habits in full detail, much of the above is abridged from Newman's 'British Moths,' p. 3, as stated in the foot-note.

Prevention and Remedies.—The best methods are shaking the caterpillars down and destroying them, catching and killing the moths when they are found coupled on the trunks of the trees which they frequent, or collecting the caterpillars or turning on poultry to clear them away from beneath the trees of which they have been observed on the leafage.

To collect the caterpillars.—Jarring or shaking the branches causes them to fall in great numbers. Any method which gives a good hard shake will answer the purpose, such as use of a pole, or throwing sticks or handfuls of gravel at colonies that may be out of reach. If they are high up on a tree, up which a man can safely climb to within reach of them, an old worn-down birch broom fastened at the end of a long pole is a very good implement. Beginning at the highest of the infested branches and working downwards, the caterpillars which may have caught on the lower boughs can thus be dislodged, and the worn-down stump of the broom makes a good instrument for raising the smaller boughs sharply, so that they come down again with a jerk, and also it will beat the boughs without there being danger (as in the use of a hard and heavy pole) of injuring soft bark.

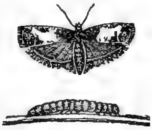
Directly the caterpillars reach the ground, it is likely that they will turn their heads to the tree from which they have been shaken, and re-ascend the stem and re-establish themselves. Therefore it is desirable, before beginning operations, to put a band of hay or straw, well tarred, on the ground round (but clear of) the foot of the tree to keep them from going up again, and to capture and kill the grubs as soon as possible in any way which may be convenient. Simply trampling on them will kill many, or, as the great size and bright colouring of the caterpillars make them very conspicuous, children would soon collect large numbers for a small payment. Where the infestation has been bad enough to make it worth while to spread sheets or cloths beneath the tree before jarring, this would save a deal of trouble in collecting, for the caterpillars might be shaken together and thrown (before they had time to escape) into pails of any mixture which would kill them.

The large size of the insect, and its habits in all its stages, throw it open to easy methods of prevention. "At the beginning of June these singular moths may be frequently found coupled in pairs on the trunks of Lime, Elm, and other trees, or on the herbage below them; the truncate heads and closely convolute wings giving each pair the appearance of a single piece of dead and dried stick." * By destroying these moths much egg-laying will be prevented.

As the chrysalids are not protected by any web or cocoon, they are very noticeable, or may easily be found by a little search on the surface of the ground or at the roots of herbage or under slight shelters beneath attacked trees, and for a small sum children might collect great numbers under trees that have been much infested. Poultry also are fond of them, and are stated to search for them with great eagerness.

Eye-spotted Bud Moth; Red Bud Caterpillar.

Tmetocera ocellana, Schiff.; *Hedya ocellana*, Fab.



TMETOCERA OCELLANA.—Eye-spotted Bud Moth and caterpillar.

The "Red Bud Caterpillars" of *Tmetocera ocellana* cause much injury both in Europe and America to Apple, and also to various other kinds of orchard fruit trees, but I have only once had definite observations of their mischievous presence in this country. Probably if the signs of the attack were generally known they would be found to be much more present than is supposed, as well as those of the "Pith Moth," *Laverna atra*, mentioned in the following paper, which they

* 'British Moths,' p. 219.

much resemble in size and general appearance, as well as date of appearance in the spring, and likewise by the presence of the attack in the spring being noticeable by the fading state of the blossoms and buds and the withering of the leaves.

But though, like the Pith Moth caterpillar, that of the Eye-spotted Bud Moth sometimes burrows a little way within a shoot, its attack is altogether of a much more external kind,—that is, as a definite injury to buds, also to blossoms and the accompanying leaves, and spinning them together; and further on in the season, by attack to leafage, of which they feed on the tissues and skin of (usually) the lowest side.

The only account which I have received of injury from this *Tmetocera ocellana* in this country was given me in 1889 * by Mr. Oliver E. Janson, when, early in May, he noticed the unhealthy appearance of many Apple trees in orchards and gardens in the neighbourhood of Hornsey (near London), and as he afterwards found some dwarf Apple trees in a garden conveniently situated for observation similarly affected, he "examined these more closely, and found the young leaves remaining stunted and shrivelled, instead of fully expanding; and towards the middle of the month all of the young shoots, many of them just showing blossom, began to droop and wither, and by the end of the month every young shoot had withered."

Various points of the observations agreed equally with descriptions of method and signs of infestation of both the Pith Moth and the Eye-spotted Bud Moth, and such turned out to be the case.

On June 8th the first moth appeared from a quantity of infested shoots which Mr. Janson had cut off and secured in glass jars under fine gauze coverings, and proved to be *Tmetocera* (=*Hedya*) *ocellana*, the Eye-spotted Bud Moth, and of this the moths continued to emerge in great numbers up to the 20th of the month.

"A few days later, and on till 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."

Of this infestation I have given an account in the following paper. It appears to have been very little written upon; but the *Tmetocera* has been the subject of much observation. So long ago as 1837 an account of its habits as a European fruit pest were given by Schmidberger in Kollar's 'Insects'; a short paper was given on it by Prof. W. Saunders, Director of the Experimental Farms of Canada, in his very useful volume entitled 'Insects Injurious to Fruits'; but it was not until more recently that the infestation was very fully entered on from his personal observations by Dr. J. Fletcher, Entomologist of the Dominion of Canada; and more recently still, with great minute-

* See my Thirteenth Annual 'Report of Injurious Insects' for 1889, pp. 81–84.

ness and excellent illustrative figure, by Prof. M. V. Slingerland, of Cornell University, N.Y., U.S.A.*

The life-history, taken in its main points from these two observers, is that the half-grown caterpillar, which may be about the sixth of an inch in length, passes the winter enclosed in silken web cells on the bark of twigs of Apple or other fruit trees. In spring it comes out of its case as a little brown larva, with a black head and black plate on the following segment, and gradually grows until in June it is about half an inch long, slightly hairy, of the above-mentioned colours, and with the legs also black.

The destructive work is begun by the caterpillars leaving their cells and creeping to the nearest swelling and opening fruit and leaf-buds, which they eat into; but it is noted by Prof. Slingerland:—"More often the caterpillar does not begin its work until the buds are nearly half-opened. It then feeds upon the central expanding leaves or flowers, tying them together with silken threads. Some of the partly-eaten leaves soon turn brown, and thus render the work of the insect quite conspicuous; one correspondent wrote that his trees looked as though a fire had swept quickly through them, as so many leaves had turned brown. This tying together of the opening leaves and flowers, and the brown appearance of many of them, are the most characteristic indications of the presence of the insect."

The caterpillars are stated to go on feeding in the spring for about six or seven weeks, mostly at night, and to turn to the chrysalis state "within a tube usually formed in the so-called nest by rolling up one side of a leaf, or by bringing together two or three half-devoured leaves, and securely fastening everything with silken threads"; the full-grown caterpillar retreats within, and lines the interior with a thin closely-woven layer of silk.

From this the moth was recorded (in the observations before me, taken in New York State, U.S.A.) to begin to come out as early as June 5th, and that often all had not emerged by July 10th. This date of appearance agrees very nearly with that recorded by Mr. Janson (p. 6), who noted the first appearance of the moths under his special observations on June 8th, and that they continued to emerge in great numbers up to the 20th of the month.

The moth is of a general ashy grey or dark ashy grey colour, and about half an inch or rather more in expanse of the fore wings, which have a broad white band or blotch across them, and have also been sometimes described as having some minute black and lead-blue

* See Report of Entomologist and Botanist in 'Annual Report of the Experimental Farms of Canada' for 1891 (published 1892), p. 195; and 'The Bud Moth,' by M. V. Slingerland, Assistant Entomologist, Cornell University, Agricultural Experiment Station, Ithaca, N.Y., U.S.A., pp. 57–66.

markings at the anal angle of the wing, and likewise near the apex. Three or four days after emerging, the moths are stated to begin laying eggs (mostly at night) on the leaves, which eggs hatch in about a week or rather more, and soon after hatching the caterpillars begin to feed on the skin of the leaf, usually on the under side. A little later the caterpillar spins a tube of silk, usually made alongside the midrib of the leaf, and open at both ends, from which it comes out to feed, and so continues to feed till some time in August or September. Then the caterpillars desert the leaves, and prepare their winter homes by spinning silken cases on the twigs, as previously mentioned, from which (as mentioned, p. 7) they issue forth in spring to attack the opening buds.

This completes the life-history of the whole year, as recorded from observations in Canada and the United States of America, with some small amount of similar observation taken in our own country.

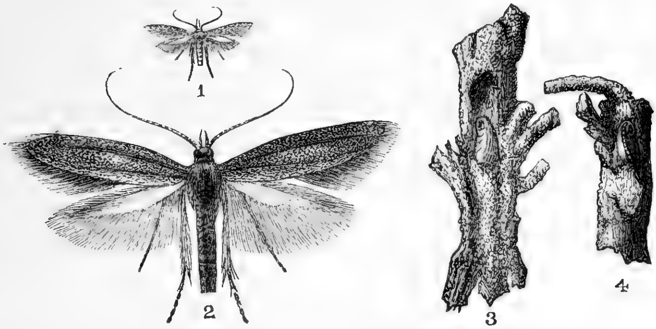
Prevention and Remedies. — The simplest and best remedy, wherever the attacked parts are in reach, is to break off the bunch of infested blossom stems and leaves, which, as above mentioned, may be known by their withered or drooping and *spun-together* state, and to burn these. If this is done before the time comes for the moth to emerge from the chrysalis, a great deal of coming attack will be prevented.

Where the infested shoots are out of reach, and the above-mentioned plan consequently impracticable, the application of arsenical sprays is advised by Prof. Slingerland (see paper quoted in note, p. 7). This, he says, to be of service will necessitate at least two thorough applications *before the flowers open*, and he gives the following recipe:—"If Paris-green only is applied, use about one pound to two hundred gallons [of water], and always add two or three pounds of freshly slaked lime, to prevent the burning effects of the free arsenic in the Paris-green. Take especial pains to thoroughly wet the buds on the smallest twigs. With at least two thorough applications of Paris-green before the flowers open, we believe this insect can be effectively *checked* for the season. Do not spray when the trees are in bloom, as many honey-bees may be killed."—(M. V. S.)

Also, it may be added that spraying when the blossoms are expanded may greatly interfere with the proper setting of the fruit.

Somewhat recently I was informed by a correspondent that the name of Paris-green was not always understood, and that consequently there was a difficulty sometimes in procuring the drug. This difficulty I should have thought would have passed away by this time; but still it may save trouble to mention that Paris-green, Emerald-green, and Schweinfurth-green are different names for the same thing, that is, aceto-arsenite of copper. The first is the American name, now very generally used in this country and many parts of the world; the second is (or was) the name more especially used with us; the third, I believe, is only used in Germany, or by German traders.

Pith Moth. *Laverna atra*, Haw.; *L. hellerella*, Dup.



LAVERNA ATRA.—1 and 2, moth, natural size and magnified; 3, chrysalis in tunnelled shoot, magnified; 4, chrysalis in bud.

Laverna atra, or the Pith Moth, is a very minute moth, of which the caterpillars probably do a great deal more harm than is generally known of, consequently on their working up the centre of the stems just below the bunches of Apple blossom whilst the buds are still unopened, the cause of the damage not being suspected till the withering of the buds draws attention to an enemy being at work in cutting off supplies of sap.

The infestation has been very rarely reported to me; but in 1889 some notes of its workings in company with the caterpillars of *Tmetocera ocellana*, or Red Bud Caterpillar, were given me,* from his own observations, by Mr. Oliver E. Janson, F.E.S., and in the past year (1898) specimens and observations of injury to Apple leaves and blossom-buds and shoots were sent me, which turned out, on rearing the caterpillars to maturity, to be the work of the "Pith Moth."

The following observations of attack, which proved to be of *L. atra* (from the moth being subsequently reared from the infested twigs), were sent me on June 20th from 21, Cavendish Road, Birkdale, Southport, by Mr. Thomas S. Webster, who wrote as follows:—

"I enclose a couple of small caterpillars which have caused considerable damage to the Apple trees this year. Last year there were a

* See my Thirteenth Annual 'Report of Injurious Insects' for 1889, pp. 81–84.

few, but this year they have been abundant, and many young Apples have withered as a result. I first noticed the creatures by observing certain bunches of leaves drooping in late April or early May, and upon breaking off a twig end, such as I enclose, there was a small reddish caterpillar, which had eaten down the stem to the woody fibre, and up as far as the point where the twig split up into leaves. In no case were the flower-buds injured individually, though of course, where the mischief had progressed, they drooped collectively."

On July 12th Mr. Webster further communicated:—

"I collected a number of the caterpillars, and after keeping these some ten days I discovered a fully-fledged moth in the box this evening."

This moth Mr. Webster forwarded to me, and on comparison with type specimens and descriptions, it proved to be *Laverna atra*, sometimes also known as *Laverna hellerella*.

On June 2nd Mr. C. S. Macklon wrote me from Edric Road, Hatcham Park, New Cross, requesting information as to an infestation in Apple twigs, of which he forwarded me specimens, with the remark that "every year before the bloom of the Apple tree from which these twigs were taken came to perfection it withered up and died off, and the leaves also turned brown and died off; where a little piece was cut off, a maggot was found within." So far as could be judged by the specimens sent without rearing the caterpillars to moth condition, this also was infestation of the "Pith Moth."

On June 27th, and also in July, I was favoured by Mr. O. E. Janson, F.E.S., of 44, Great Russell Street, W.C., with some notes of his own observations, and specimens of damage caused to Apple twigs by this infestation, and also of Pith Moths reared by him from the infested twigs, which are of valuable interest. Mr. Janson mentioned on June 27th that he had found some dead buds (on the Apple trees in his garden near London) which contained a small pupa in an excavated longitudinal central tunnel. These he collected with the view of rearing the moths, and on July 8th Mr. Janson wrote me that he had observed (that morning) that a *Laverna atra* had emerged from the Apple buds, but nothing else at present; * and on July 15th he further mentioned that he had sent me three of the *L. atra* that morning. From these the specimens given life size and magnified at p. 9 are figured.

The moth is only half an inch or hardly so much in expanse of the fore wings. These are narrow, and to the naked eye appear merely of a somewhat varied black or deep brown colour. When moderately magnified, they will be seen to have a very irregular white streak

* In the year 1889 attack of the Red Bud Caterpillar, *Tmetocera ocellana*, had occurred *accompanying* that of *L. atra*.

running along the inner edge of the wing from the base to the extremity, this being of various widths, or having two or three branches diverging towards the middle of the wing. The dark part is more or less varied with tawny, and the light with most minute specks of black; but the great variations of colouring make it almost impossible to describe it serviceably.* In the three specimens before me the right and left fore wings vary from each other to some degree in every instance, as seen by a two-inch object glass. The fringes are grey. The hinder wings are grey, with the fringes paler. The head and face white; the horns (*antennæ*) fuscous, with paler rings.

The specimens sent showed, as figured at p. 9, the change of the caterpillar to the chrysalis condition taking place in the tunnel which it had worked out along the centre of the twig, or at the extremity of it, where the empty case is figured as partly exposed in a destroyed leaf-bud at figure 4. Figure 3 shows another specimen lying amongst the "frass," caused by its working in the tunnelled twig. The chrysalis was about three-sixteenths of an inch long, and the sheaths of the antennæ remarkably noticeable. The caterpillar was of a reddish or brownish colour; but I am unable to give the details, consequent on illness at the time being much in the way of my own observations, and also, after much search, I have been unable to find a detailed description of the larva of this species of *Laverna*.

The description of the habits of the larvæ, as given by Herr Mühling,† is that they hybernate under the bark of an Apple twig close by a bud. In May they bore onwards into the young growing shoot, and feed on the pith (whence the name of Pith Moth). They also eat up the middle of the stem beneath the bunch of flowers, and thus cause the budding blossoms to wither and perish, even to the extent of the destruction of the whole bunch.

Comparison of these notes with those of our British observers mutually confirm each other, and attention of Apple growers should especially be given to the *distinguishing* characteristics of this infestation being that the larva or caterpillar feeds within the stem, and there or at the tip of its working, partly exposed in a leaf-bud, it turns to the chrysalis state. Thus, from cutting off the food supplies, the cluster of Apple buds perishes; but, as noted by Mr. Webster at p. 10, I do not know of any instance being recorded of the flower-buds being "injured individually," though of course where the mischief has progressed "they droop collectively."

* For minute description of what is considered the ordinary marking, with notes of some differences of colouring, see Stainton's 'Tineina,' pp. 239, 240.

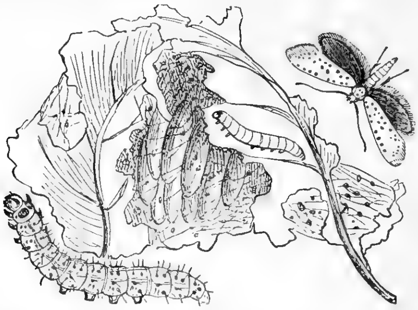
† See observations by Herr Mühling quoted in 'Praktische Insektenkunde' of Dr. E. L. Taschenberg, pt. iii. p. 287; and 'Die Pflanzenfeinde' of Herr Kaltenbach, p. 781.

Thus the attack may be distinguished from that of the Red Bud Caterpillar of *Tmetocera* (=*Hedya*) *ocellana*, or Eye-spotted Bud Moth, of which an account will be found in the preceding paper. In this case (that of *T. ocellana*), though the caterpillars at times tunnel along the centre of the shoot, they work in the opening leaf- and fruit-buds, and presently tie the central leaves and flowers together with silken web, in which they turn to the chrysalis state; in summer, it is stated, the newly-hatched caterpillars may be found feeding on the lower side of the leaves.

It is said by Heineman that the caterpillars of *L. atra* live in autumn in the fruit of *Cratægus;* and Stainton * also says,—"Larva in hawthorn berries in September; the black variety in budding shoots of Apple in February and March."

Prevention and Remedies. — These appear solely to consist in cutting off ends of twigs where, by the withering away of the Apple blossoms, the presence of the attack is observable, and burning these, so as to destroy the infestation within before it has passed to the moth condition, and can fly abroad to set new mischief on foot.

Small Ermine Moth. *Hyponomeuta padella*, Linn.



Hyponomeuta padella.—Small Ermine Apple Moth, caterpillar, and cocoons, life size; and caterpillar, much magnified.

Amongst the leafage attacks regarding which inquiries were sent in the course of the past season were those of the caterpillars of the "Small Ermine Moth," which have been so often referred to before that it would not be necessary to notice them again, but for a successful method of getting rid of them on no less a scale than when stripping the leaves of seventy yards of a Hawthorn hedge having been communicated to me too late for insertion in my 'Handbook.'

* Stainton's 'Manual of Butterflies and Moths,' vol. ii. p. 398.

The life-history of the infestation, put as shortly as possible, is that the little moths lay their eggs in patches on twigs of the attacked trees, chiefly on Apple or Hawthorn, from which the caterpillars may be found hatched by the beginning of October; these live through the winter, but attention is usually first drawn to their presence in spring or early summer, when they may be found feeding in large numbers on the leaves, and spinning web-nests, in which they shelter in companies. When full-fed, the caterpillars each spin a separate cocoon of light texture in the web shelters (see figure, p. 12), within which they turn to the chrysalis condition, and from which the moths come out about the end of June.

The caterpillars when first hatched are about one-twenty-fourth of an inch in length, yellow in colour, with black heads; they afterwards turn to a dirty ash (or possibly pale ash) colour, spotted with black; and when full-grown, the ground colour is of a dirty yellow or lead colour.

The moth is of the size figured, with rather narrow fore wings about three-quarters of an inch in expanse, and usually livid or whitish dotted with black, the hind wings livid or lead colour; but the tint is very variable. The species or variety figured at p. 12, of which the fore wings of the moth have the black spots on a pure white ground, and of which the cocoons are opaque, was at one time especially distinguished as *Hyponomeuta malivorella*, or Small Apple Ermine Moth, and was considered more especially to frequent the Apple. But however this may be, there does not appear to be any difference in the life-history requiring different treatment.

Prevention and Remedies.—The usual remedies for this attack where the infested boughs are so clear of each other that the webs can be cut off are well known. Then the web-nests should be cut off, when the caterpillars are within, and allowed to fall into a pail of any fluid held below which will prevent them escaping. Or the caterpillars can be shaken down to some extent by jarring the infested boughs, and destroyed; or syringings with soft-soap and a little paraffin oil mixed with it answer well; or even, where there is a good water supply, *thorough hard* washings sent at the tree of water without any admixture I have known to clear the tree very effectually. It was not, however, until the past season that I had an instance of treatment being successfully carried out on a long length of tall hedge.

On July 5th the following communication, with specimens of *H. padella*, with larvæ (some full-grown), and some pupæ spun up side by side in the manner figured at p. 12, were sent me from The Rectory, Caterham, Surrey, by the Rev. Fred. A. Bright:—

"I am advised to send for your inspection specimens of a quickset hedge taken from my glebe. The blight commenced on Sunday, June 26th, and in three days about seventy yards of the hedge was devoid of foliage. The hedge is six feet high, and very thick; it is the work of millions of small caterpillars, as you will see by the specimens. I had the hedge syringed with soft-soap and water, which seems to have good effects; but in places the blight is still going on. What is it, and what is the best remedy? . . . The blight appears to be confined to my premises, with the exception of a hedge on the other side of the road."—(F. A. B.)

In reply to Mr. Bright's inquiry, I wrote, on July 7th, as follows:—

"In the present case the remedy which is being applied of syringing with soft-soap in water is very good, but a *little* paraffin oil well stirred into it would make the mixture more effective. . . . Only it must not have enough paraffin or mineral oil added to burn the tender bark, and the mixture should be so constantly stirred as to keep the oil and soft-soap wash thoroughly incorporated."

On August 13th Mr. Bright was good enough to tell me that on returning, after an absence from home, he found that the remedy I had suggested had been in every way effectual, and the hedge was as green as ever, with a superabundance of foliage. Further, on October 1st, in reply to an inquiry I sent, Mr. Bright mentioned that the application of the soft-soap and a *little* paraffin oil had been "a great success."

The success of this broadscale application seems worth recording, as it is one that can be carried out at no great cost, either for material or labour; and, so far as I am aware, we have not previously had any note sent of definite treatment for getting rid of these caterpillars as hedge-leafage pests.

If the application of the kerosine emulsion so much used against leaf-feeding caterpillars in the United States of America and Canada should be preferred, the following recipe, which is one published by the Department of Agriculture of the United States of America, will be found serviceable. 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.*

This point of testing the strength that can be borne by different kinds of leafage and by leafage in different conditions is exceedingly important, and so also is the matter of the soft-soap and the mineral oil being so *thoroughly incorporated* that they will not separate. If they do, the mineral oil will be sure to cause much injury to the leafage on which it may fall without being diluted by the soft-soap mixture.

NOTE.—Besides the above-mentioned attacks, inquiries or communications were received regarding almost all the commonly injurious Apple infestations, as, for instance, the American Blight, *Schizoneura lanigera;* Apple Aphis, or Green Fly, *Aphis mali;* Apple Mussel Scale, *Mytilaspis pomorum;* Apple-suckers, *Psylla mali.* Also the Apple-blossom Weevil, *Anthonomus pomorum*, and the Clay-coloured Weevil, *Otiorhynchus picipes*, which was unusually troublesome, and is noted under the heading of "Hops." The Codlin Moth, *Carpocapsa pomonella*, was, almost as matter of course, present. In fact, with the exception of the Apple Sawfly, *Hoplocampa testudinea*, almost all the ordinary infestations were noticeable; but as they have all been entered on in detail before in previous Annual Reports, or in my 'Handbook of Orchard and Bush-fruit Insects,' * it has seemed unnecessary to allude to them again, excepting a few words about the two following occasional infestations.

THE GREAT CATERPILLARS OF THE LAPPET MOTH, *Gastropacha quercifolia*, which have been very rarely reported as injurious to orchard leafage, appeared again in May on Apple, and in a new locality, near Winchcombe, in Gloucestershire. These caterpillars are easily observable by their great size, being as much as upwards of four inches long. The colour is greyish or brownish, with a row of more or less observable markings down the middle of the back, these marks being sometimes of a dark V-shape. The caterpillars are fleshy, cylindrical, somewhat hairy, with a row of fleshy protuberances along each side just above the feet, to which the name of "lappets" has been given. The cocoon in which the change to chrysalis takes place is spun in any convenient shelter, and from these the moths, which are of a rich brown ground colour, and may vary in size (in male and female respectively) from two to three and a quarter inches, may come out from May to August.

* London: Simpkin, Marshall & Co. 1898. Price 3*s.* 6*d.*

The caterpillars appear to winter in partly-grown condition extended along a twig of their food-plant, and as they attain maturity are excessively destructive, clearing the leaves wholly away down to the very footstalk.

The best remedy is hand-picking.

The caterpillars of the "Eyed Hawk Moth," *Smerinthus ocellatus*, are of a green ground colour, with the skin rough, dotted with white, and having seven white stripes slanting backwards at the top on each side, the seventh stripe being continued up the horn-like process at the tail extremity of the caterpillar, which is pink whilst the caterpillar is young, and afterwards changes to pale or sky blue, with a greenish or black tip. These are sometimes three inches or more in length.

The caterpillars are at times exceedingly destructive to Apple leafage, and when full-fed turn to a red brown chrysalis a little below the surface of the ground, from which the large and handsome moth (which is of a rosy brown or ash colour on the fore wings, and has a large eye-like spot in the centre of the hinder wings) comes out during the following summer.

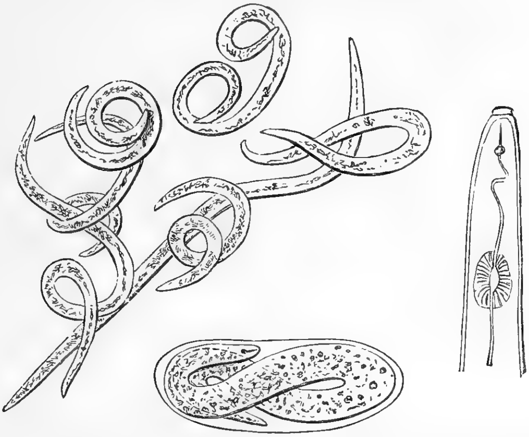
The best remedial measures are hand-picking, or jarring down the caterpillars, or skimming off the surface soil with the contained chrysalids during the winter.

This attack will be found entered on in detail in my Eighteenth and Nineteenth Annual Reports; and that of the Lappet Moth in my Seventeenth and Eighteenth Annual Reports, and also in my 'Handbook,' with life-size figures of the large moths and caterpillars.

CLOVER.

"Stem-sickness" caused by Stem Eelworms.

Tylenchus devastatrix, Kuhn.



Tylenchus devastatrix, Stem Eelworms.—Anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified: anterior portion magnified 440 times. From figures by Dr. J. Ritzema Bos.

In the course of the year 1897, "Tulip-root" appeared to be more than usually prevalent in the Oat crop, and during the early part of 1898 much more inquiry was sent than is generally the case as to the cause of the serious failure of Clover in various parts of the country. Whether there was any connection between the attacks I cannot tell, but in a large proportion of the cases in which specimens of diseased Clover were sent to me for examination, I found them to be suffering from infestations of the "Stem Eelworm," *Tylenchus devastatrix*, which also cause much mischief by giving rise to the attacks known as Tulip-root and Segging in Oats.

The dates of inquiries in the past season (1898) ranged from January 26th to April 4th, and were from various parts of Yorkshire and Lincolnshire; likewise from localities near St. Ives, Hunts; Peterborough, Northamptonshire; Hollesley Bay, Suffolk; Rochford, Essex; Edenbridge, Kent; and Malvern, Worcestershire.

In almost every instance specimens of the diseased plants were sent for examination, and in about three cases I found outside the roots some amount of the white maggots of the well-known Clover and Pea Leaf Weevil (*Sitones*, scientifically), which sometimes do much harm at Clover roots, but (in the above instances) were far too few in number to account for the serious amount of mischief present. These larvæ were about a quarter of an inch long at full growth, plump, wrinkled, legless, and with a horny brownish head furnished with strong jaws.

In a single instance I found presence of the "Red Maggot" of the Clover-leaf "Gnat Midge," *Cecidomyia trifolii*, which are of very similar size, shape, and colour to the well-known "Red Maggot" of Wheat; but here also, both from what has been observed of their habits, as well as the very limited amount of their presence, there was no reason to suspect them of causing the mischief.

Besides the above, there were various other presences, as of worm-like larvæ of two-winged flies, young earthworms, or allied annelide worms; also the small knob-like growths, or galls, so often found on the roots of Clover and other leguminous plants, were inquired about, but in no case could the injuries be attributed to any of these.

Above ground the case was different. There was some amount of fungoid presence, as well as very much of "Stem-sickness," demonstrably caused by presence of the Stem Eelworm, *Tylenchus devastatrix*, and as the characteristics of the two attacks are completely different it cannot fail to be of use to give the following short notes from the official Reports of Mr. W. Carruthers, F.R.S., Botanist to the Royal Agricultural Society,* as conveying most valuable information as to the characteristics and prevalence of the fungoid attack.

In his Reports (noted below) Mr. Carruthers mentioned the injury to Clover caused in many parts of the country by the parasitic fungus *Sclerotinia trifoliorum*, with the observation in his Report of April 6th that "throughout the middle and south of England the destruction of Clover by this parasite has been very serious." With the returning growth, however, the presence of the pest to a destructive extent seems to have passed away, as in Mr. Carruthers's Report of May 25th he mentions that "no case of active injury has been observed during the month."

The description of the characteristics of this fungoid attack, from which I extract a few of the main points (given in Report for February, p. xxiii), is well worth notice as showing at a glance the distinctions in appearance of the Clover growth when suffering respectively from this fungoid disease, or the deformed growths caused by presence of the "Stem Eelworm."

This parasite (*Sclerotinia trifoliorum*) shows itself by the dark, almost black irregular-shaped spots on the leaves. "These are the spores of the fungus. . . . The mycelium, or roots, of the fungus pushes its way through the parts of the plant above ground, killing

* See Reports of Consulting Botanist for February, March, April, May 4th, and May 25th in Parts II. and III. of 'The Journal of the Royal Agricultural Society for 1898.'

them and reducing them to a wet disorganised pulp." Other details, as well as observations of another fungoid attack (*Peronospora trifolii*), are given; but I quote the description of the method of destruction of leafage by the widely spread *S. trifoliorum* as being completely different from the *characteristically* deformed growth of buds and shoots, which unfortunately we have had only too much opportunity of knowing for some years back as the effect of the infestation of *Tylenchus devastatrix*, or Stem Eelworm.

I also have much pleasure in adding a few lines I was favoured with by Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory at Amsterdam, relatively to information he had given me when I had the advantage of some conversation with him here early in the year:—"I said that in Holland I often found a very dangerous Clover-sickness caused by the fungus *Sclerotinia trifoliorum* (=*Peziza ciborioides*). This Clover-sickness is in Holland much more common than the Clover-sickness caused by *Tylenchus devastatrix*. It sometimes occurs that both diseases attack the same plant. *T. devastatrix* causes an abnormal growth, and can cause *at length* the death of the Clover plant; *Sclerotinia trifoliorum* causes the death of the plant after some days."—(J. R. B.)

In by far the greatest number of samples of injured Clover sent to myself, mischief was demonstrably to be attributed to Clover Stem-sickness, caused by *Tylenchus devastatrix*, or Stem Eelworm, as shown by the peculiar form of diseased growth to which this infestation gives rise, and also by the presence of Eelworms in the diseased shoots and buds.

The Stem Eelworm is a minute, transparent, white "threadworm"; when full-grown, only about one-twenty-fifth of an inch (about half a line) in length, and its greatest breadth is about one-thirtieth of its length. The very small white worms often seen at the roots of plants, which may be worm-like fly larvæ, or very young "earthworms," or nearly allied to them, are sometimes mistaken for *Tylenchi;* but these may be a quarter of an inch or more in length, and the fact that they *can be observed* without difficulty by the naked eye shows at once that they are *not* "Stem Eelworms."

The figure at p. 17 shows the general appearance of *Tylenchus devastatrix* when much magnified, and the right-hand figure shows a special characteristic of the *Tylenchi*, of presence in the *œsophagus* (or "gullet"), by which they suck in their food, of a sharp needle-like process, called the spear, placed on a bulb-like base, which, when much more magnified, will be found to be *trilobed*. There is also in the case of this species a characteristic distinction in the structure of the male; but as the greatest length of these wormlets is only about one-twenty-fifth of an inch, these distinctions, which are only observable with the help of high microscopic powers, are of little service for general use. The wormlets propagate by egg-laying, and may be found in egg and young state and also as fully-formed males and females together in the misshaped stems and leaf-buds of the infested Clover.

In the case of Clover "Stem-sickness" in the early part of the year, the circumstance of the stalks and branches being shorter and thicker than in healthy growth is characteristic of attack, joined to the altered state of the buds themselves, which may be found much thickened in shape; often a number of them growing solitarily on the crown of the plant being of an irregularly enlarged and prolonged oval or bulb-shape. When attention is drawn to the attack in its winter condition, probably many or most of the above-described form of buds and of the diseased shoots and branches will be found to be dying or decaying; but where the mischief is not so far advanced, the Stem Eelworms may be found both in young and mature state in the plants.

In summer the characteristic malformations are much more fully developed, and, as late as when the flowering-heads are still present, attacked growths may be found in the form of short barren shoots about an inch long, of oval shape, and with the leaf-growths distorted so as merely to overlap each other, and form a kind of tile-like imbricated exterior. These shoots are placed close together, and, where I have seen them, as many as five grew on an inch length of stem, one at the end, and two on each side, so as to form a flat fan-like mass. The shapes varied; they were commonly irregular, and oval, and somewhat bulb-shaped, or much prolonged, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base. In various of these shoots I found the Eelworms present up to numbers which might be described as "swarming" in the palish brown powdery, or rather granular, matter in the hollow near the base, or other parts of the perishing shoots.

But it is usually the spring or rather the winter condition of which samples are sent me for identification; and in the past year the first inquiries were sent me in the last days of January as to great damage that was being done to Clover, *stated* to be by grubs sent. These were larvæ of the Clover-leaf Weevil (*Sitones*), but I saw no reason (from so much information as was sent me) to attribute the mischief to these grubs, and on examining samples of the diseased plants sent me on February 3rd, from Skirbeck-Quarter, Boston, by Mr. G. Rainey, I found them to be suffering from Eelworm Stem-sickness. There were the long misformed buds and deformed shoots (now brown) which are characteristic of this attack, and within these, where I examined, Eelworms of different degrees of development were numerously present. These were, when I began examination, torpid, but the youngest specimens soon began to recover power of active movement in the warm room, and likewise some of the older specimens, whilst I continued examination. The Clover was the "Common Red Clover," *Trifolium pratense*, but the seed was mixed of two different kinds, about two-thirds "English Red," and one-third "Russian Red," and sown in the preceding April "in the usual way in a corn crop."

On February 14th, specimens were sent me by Mr. Arthur Alsebrook, from the Yorkshire College, Leeds, of diseased Clover plants and maggots, which proved to be (as above) of *Sitones*, or Clover-leaf Weevil, with the observation that he considered the larvæ appeared to be the cause, in the East Riding of Yorkshire at least, of the dying off of the Clover, "which is so prevalent throughout many parts of the country." On examination, I found that, besides the weevil maggots, there was Stem Eelworm attack, but only a few of the Eelworms noticeable, for the samples of diseased growth sent were very small.

On the 18th (that is, four days later) Mr. Alsebrook wrote to me again, requesting my opinion on a series of specimens of Clover, of which he wrote:—

"They are all from the same district (near Howden, in the East Riding), and were taken by me yesterday and to-day.

"No. 1 had many weevil larvæ in it, which I have kept.

"No. 2 has many thread-like worms, of which I should be glad of particulars.

"No. 3 has at the roots of one plant some very peculiar growths, which I should also be glad to have particulars of."—(A. A.)

These specimens I examined, and in the case of "No. 1," from which "many weevil larvæ" had been taken, I did not find that there was injury attributable to *Sitones* maggots, but there were live Eelworms present in the stem part of the abortive bud examined.

"No. 2," small worm-like creatures, from size, shape, and presence of a brown head with two antennæ, presumably a species of *Sciara* (a two-winged fly), and feeding on decayed matter.* Eelworms of different sizes present and in active condition. The red maggots of a *Cecidomyia*, or Gnat Midge, were also present. These little larvæ are legless, cylindrical, pointed towards the head end, and are especially recognizable by having beneath the body (near the head) a horny organ, known as the "scraper" or "anchor process." This consists of a narrow stem, of which one end is fixed to the larva. The other end, which is free, and enlarged, and points forward, varies much in shape; sometimes it is bifid, but in the present case is widened and prolonged in the middle into a somewhat flattened triangular shape. The maggots consequently were presumably larvæ of the Clover-leaf Midge, *Cecidomyia trifolii*, now in hybernating state, which, when in

* See 'Farm Insects,' by John Curtis, pp. 460, 461.

active condition, infest the lower leaves of Clover, fastening them so that the bent edges fit together into a shape like a little pod, within which the maggots feed and change to pupæ, from which the little two-winged Gnat Midges, which may be generally described as of some shade of brown, presently develop. The maggots may be very easily recognized by their resemblance to the common Red Maggot of Wheat.

In 1889, similar specimens were sent me from diseased Clover at Woburn; and on April 3rd in that year, Prof. Herbert Little sent me specimens from Clover roots near Wisbech. I had them also from Rothamsted, and also from Chelsing, near Ware, in connection with Stem-sick Clover; but I could not find that in any instance they were doing more than sheltering in, or *possibly* feeding on, the decayed matter of the dead root or bark. I did not in any case find them feeding on living stems, and as in the case of experiments at Rothamsted the "red maggots" were still to be found at Clover roots after the plants had been thrown into vigorous growth, it did not appear likely they were the cause of damage.

"No. 3" of Mr. Alsebrook's inquiries referred, on examination of his specimens, to the little knobs or gall-like growths which are so often to be found singly, or in small numbers together, on the roots of Clover, Pea, Bean, or other leguminous plants. Other inquiries as to other presences in the Clover were sent, but do not require special notice.

On February 25th I received some very characteristic specimens of winter condition of Stem-sickness in Clover from Mr. M. A. Streatfield, of Chested, Chiddingstone, Edenbridge, Kent, with the following observations, amongst which it will be noticed that the infested field was in Oats in the previous year, which might bear importantly on the matter:—

"I am sending you some Clover plants from a field where the Clover is rapidly dying in patches. Is it the effect of Stem Eelworms, and do you think the attack is likely to increase? The plant on the whole is wonderfully strong and healthy. The field was Oats last year, manured with guano. . . . P.S.—I find small white maggots among the roots of every plant, but I do not think they are injurious."

On February 27th Mr. Streatfield wrote further:—

"Might I ask if you have any experience as to the action of sulphate of potash, whether it is injurious to the Eelworms, or merely stimulates the weakly plants? It is rather a big expense to top-dress the whole field, but bad patches might easily be treated.

"Also whether Oats from a Tulip-rooted crop would be likely to spread the disease if used as seed?

"I may add that the Clover field in question is sown with Red

Clover, Trefoil, and Rye Grass, and that at present only the Trefoil plants seem affected. A field of my neighbour's, sown entirely with Trefoil (the same seed as mine), is nearly half spoilt."—(M. A. S.)

In regard to Mr. Streatfield's inquiries, firstly, as to effect of sulphate of potash. I am not aware of any series of experiments having been instituted to trace disappearance of the Eelworms from the infested plants. But we know that the diseased growth soon ceases, and likewise that where the sulphate dressings (mentioned further on) are given at sowing time, this kind of sickness has not appeared, or slightly; therefore it has seemed to me safe to consider that the dressings have a definitely injurious effect on the wormlets, as well as helping the plant against them by increased luxuriance.

Secondly, whether Oats from a Tulip-rooted crop would spread the disease if used as seed? There is no reason to fear this; but litter formed of parts of the Oat-straw in which the wormlets harboured would be *very likely indeed* to carry the disease to any crop liable to infestation to which such litter was taken.

The following observations regarding Clover perishing from some cause unknown to the sender were forwarded to me, together with specimens of the attacked plants, on February 18th, from The Walnut Trees, Bluntisham, St. Ives, Hunts, by Mr. Tebbutt:—

"I forward with this specimens of Clover plants which are suffering from some cause unknown to the farmers in this locality. I have two fields of about thirty acres, on which I think two-thirds of the young Clover plants are destroyed. These young plants are in envelope No. 1. In No. 2 are two or three specimens, also affected, of Clover two or three years old. Some plants are apparently still fading away. In some I think (doubtfully) there are signs of a fresh shoot, but generally the plants affected seem to be quite destroyed.

"All the fields of yearling Clover (sown in the spring of 1897) are, so far as I can learn, seriously affected.

"At first many persons thought the cause was 'Clover-sickness,' but fields that have not been Clover for a long period are affected.

"I have seen some small worms on the decayed plants, but I do not at all know whether they were the cause or the effect of the decayed plants.

"The decayed plants in envelope No. 2 are from fields of two or three years old Clover, but in these fields the decayed plants are rare."

In No. 1 packet there were but few characteristically deformed shoots, and no Eelworms, so far as I could ascertain, were present; but on the large old plant in No. 2 packet I found distorted enlarged buds and short shoots, in which live Eelworms were present.

The presence of Eelworm Clover-sickness on fields which have not been in Clover for years may easily be caused by other crops liable to the Eelworm infestation having been on the ground, or manure having been used from infested litter; but if specimens of the plants of field No. 1 had been submitted to an expert in fungoid disease, in all probability some one or other of the kinds of fungus, or mould, of which Mr. Carruthers noted the prevalence, would have been found present.

On February 28th, Dr. Robert Johnson, Director of the Colonial College, Hollesley Bay, Suffolk, when communicating with me on some other subject, added :—

"While writing (at this moment) the enclosed have been brought to me; I have not examined them. To the naked eye there would appear to be some fungus. I send them to you just as they are, in case they may be interesting. The message brought to me is—'There are some acres going off like this.' "—(R. J.)

In this case (and looking only to the points on which I was qualified to offer an opinion) I found some small brown shoots present similar in form to those in which I have lately found Eelworms in diseased Clover. As mentioned above, I did not trepass on the field of fungoid identification, in which I am not skilled.

On March 5th, Mr. Henry Howman, Director of Agriculture of the Agricultural Sub-Committee, Gloucestershire County Council, wrote me as follows from Gloucester:—

"I have had numerous complaints from farmers for some time past that their Clover plants are dying without any apparent reason, and on all kinds of soils—stiff and light soils. I venture to send you some plants from a stiff land. You will notice the leaves are going rotten, as if they were damping off. . . . The dying plants are not in patches, but here and there."

The plants of Clover sent in most instances had some very vigorous shoots, but also in some instances one or two, in some approximately six to a dozen, abortive brown shoots, precisely similar in shape to those in which I have lately found presence of Eelworms; and in this instance also Eelworms were present in some of the abortive shoots. Presumably (from Mr. Howman's observations) this also was a case of coincidence of presence of Nematoid worm and fungoid attack.

On March 23rd, Mr. John Crisp, writing from the Estate Office, Elton Hall, Peterborough, mentioned having lately found white maggots amongst the Cow-grass on the estate, and sent me specimens, which turned out (as in some of the other cases observed) to be maggots of the Clover and Pea-leaf Weevil (*Sitones* of various species), of which the perfect beetles not unfrequently do widespread damage at the leafage in spring or summer, and the maggots are to be found at the roots in winter, by which they turn to the chrysalis condition in the earth, and from this state the beetles develop towards the beginning of summer. But though sometimes the maggots do a deal of harm at roots, I am not aware that they were in fault in this case.

An account of a large quantity of a good plant of Clover dying off in a most unusual manner at a locality near Malvern was not accompanied by specimens which gave opportunity to identify the attack satisfactorily.

The latest inquiry which was forwarded was sent me by Mr. E. Wightman Bell, F.C.S., from High Bridge, Spalding, on April 4th, with a specimen accompanying, and the observation that I was no doubt aware that the Clover crops were dying off to a very great extent, and he would be glad to know if the pests forwarded were the cause; also that it was to be noted that the more solid portions of the fields have not suffered as much as the lighter, and the same applies to those fields which were well trampled by sheep.

The specimens sent showed presence of Stem Eelworm Clover-sickness; but it is well worth note that in a further communication, Mr. Wightman Bell, who is well qualified to report on the subject, mentioned that in almost every case he had observed *mycelium* threads on the leaves of affected Clover.

A summary of the reports sent of the widespread prevalence of Clover disease during the early part of last year (1898) shows, from the observations of Mr. W. Carruthers in his official Reports to the Royal Agricultural Society, that there was great destruction by "sickness" due to fungoid presence, especially that of *Sclerotinia trifoliorum;* and from reports and specimens sent to myself there was also, I found, a great prevalence of sickness caused by presence of Stem Eelworm, *Tylenchus devastatrix.* These two attacks may occur separately or coincidently, and in some of the attack of which specimens were especially observed, as in those above noticed reported on by Mr. Wightman Bell, both the fungoid and Nematoid infestations appear to have been present.

Other infestations, as of weevil maggots (larvæ of *Sitones*), and of Clover "Red Maggots" (larvæ of *Cecidomyia trifolii*), were present; and the first of these is known to do mischief at times at roots of Clover, though, so far as I am aware, it has not been recorded as often causing much damage. The Cecid larvæ (the "Red Maggots") may fairly be presumed to be harmless, as we find them in the *decayed* matter of the roots, also we have *no* evidence of their feeding on the living tissues in their winter subterranean conditions, and also we know that when the maggots are in active state in summer they have a peculiarly distinctive method of feeding,—that is, by fastening the edges of the selected Clover leaf together, and within this shelter feeding and turning to the chrysalis state.

Specimens of other kinds of presence—such as insect larvæ, small worms, galls on the roots, &c.—were sent or referred to, but there was no reason for supposing any of these to be doing harm.

It would save a deal of trouble, and likewise delay in applying proper remedies, if two points regarding signs of Eelworm Stem-sickness were more thoroughly known.

One is that if the minute white worms or worm-like creatures so often seen about the roots are perceptible to the naked eye, this very circumstance shows that they are *not* Stem Eelworms. These are only one-twenty-fifth of an inch (or about half a line) in length, and if any reader will take the trouble of trying to mark this amount of an inch on a foot rule, he will be at once convinced how impossible it is to notice a presence of worms of only the above length, and of only a thirtieth part of the breadth, without magnifying powers.

The other point is that the Stem Eelworm attack is the *only one* of all those noticed in the preceding pages which is characterized by a definitely deformed kind of growth of shoots and buds, and observation of this very peculiar nature of growth whilst still it was living and open to the application of means of prevention and remedy would probably save much loss.

Prevention and Remedies.—Observations on the nature and treatment of Eelworm infestation will be found entered on in my Annual Reports mentioned below.*

In the Tenth Report, besides considerations regarding the infestation itself, valuable directions by Dr. Julius Kuhn as to eradicating the pest by special cultivation of the ground and avoiding of infested manure will be found.

In the Eleventh Report notes are given of this *T. devastatrix* as infesting Carnations, Clover, Oats, Rye, and Wheat, but *not* found to infest Barley; and at p. 70 various common grasses, weeds, &c., are named which have been found liable to infestation.

In the Twelfth Report are special notes of successful use of sulphate of potash and other dressings.

In the Thirteenth Report I give, by permission of Dr. J. Ritzema Bos, to whom I have been constantly greatly indebted in the course of my observations for identification of species and other valuable assistance, a full-page plate,† with figure of the male and also the female of *T. devastatrix* magnified 200 times, and of the anterior portion of one of these wormlets magnified 440 times, with magnified figures of eggs, &c., and explanation of plate accompanying. Details are also

* See Tenth to Fourteenth Annual Reports of Observations of Injurious Insects, also Eighteenth, Twentieth, and Twenty-first Annual Reports.

† See Plates I. and II. in 'L'Anguillule de la Tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. à l'Institut Agricole de l'État à Wageningen (now Director at the Laboratory of Phyto-pathology at Amsterdam).

given, amongst other points entered on, of various applications found successful at Rothamsted in checking Eelworm Clover-sickness and pushing on good growth.

In the Fourteenth Report, special account of this attack as affecting Field Beans, with identification by Dr. Ritzema Bos of *T. devastatrix* as the cause of the stunted and deformed growth, and life-size figure of one of the attacked plants.

In the Eighteenth Report, the discovery by Prof. J. Percival (of the South-Eastern College, Wye, Kent) of presence of Eelworms showing no apparent specific distinction between them and *T. devastatrix*, and found by him in Hop roots, is mentioned. This is a matter of much scientific interest relatively to the position of the wormlets being not in the stem or buds, or modifications of those parts, but in the roots. Regarding this infestation Dr. Ritzema Bos, to whom specimens were submitted, observed:—

"I found in the larger parts of the roots which Prof. Percival sent me, in the cortex close to the bast, Nematoid worms closely allied to, if not identical with, *Tylenchus devastatrix*. I never found *T. devastatrix* in roots, always in stems and leaves (also in subterranean caulomata and phyllomata). . . . The *Tylenchus* in *Humulus* roots is somewhat smaller than *T. devastatrix*, but as this species varies much in length, that would be no cause why it should not be *devastatrix*. . . . The *Tylenchi* in the Hop roots are smaller than the *T. devastatrix* in other plants, but the maximal length of those of Hop roots surpasses the minimum length of *Dipsacus* (according to Kuhn: I myself never found so small ones), and as I cannot find any other constant difference between the Hop-root *Tylenchus* and *T. devastatrix*, we may say that the Hop-root *Tylenchus* must indeed belong to this species. It is the first time that I find *T. devastatrix* in the roots; I always found it in the stems and the leaves only. It is curious that I found in the Hop roots a very large number of males, also larvæ, but only a very small number of females."—(J. R. B.)

Other observations on the subject by Dr. Ritzema Bos, and communications with which I was also favoured by Prof. Percival, will be found in the same paper.

In the Twentieth Report, detailed observations will be found—pp. 107–115—on the misshapen swelled and cracked growth of Onions, caused by infestation of *T. devastatrix*, or Stem Eelworm. This "Eelworm-sickness" has been known for about twelve or more years as injurious to Onions in Holland, but has not been reported as present in this country until 1896, in which year full observation of the characteristics of the damaged bulbs and swelling of the flag or leaf above the bulb were sent me, and I also found the attack present, so as to be able to study it, in my own garden.

In the Twenty-first Report "Eelworm-sickness" is again alluded to, consequently on its prevalence in that year, or at least observations regarding its presence, as causing Tulip-root in Oats, beginning on May 6th and continuing at intervals during the summer from widely separated localities, from as far north as Pincaitland, Midlothian, N.B., to Chested, near Edenbridge.

In the above-named Reports accounts will be found of (I believe) all the attacks to different kinds of crops which have been found from 1886 onwards to be subject in this country to injury from presence of *T. devastatrix*, with description of the characteristic appearance of the deformed growth due to the presence of this Stem Eelworm, so as to enable observers to distinguish almost at a glance the nature of the mischief that is going forward.

With the advance of information as to measures of successful treatment, or of measures which *cannot* be trusted to, or any other points, whether of cultivation, habits of the Eelworm, or observations bearing serviceably on the subject, these have been successively added. Also, to save trouble in reference, the technical description of the Eelworms has been frequently repeated, and occasionally also a full-page plate of the male and female Eelworm, greatly magnified, for use of which, as well as for identification of specimens and much valuable information, I am greatly indebted to the kind help of Dr. Ritzema Bos, the well-known observer and writer on these Nematoid worms, whose assistance in permitting inquiry, as well as by reference to his published works, I have gratefully acknowledged throughout the observations.

The methods both of prevention and remedy of the attack have gradually become well known, and are given in the above-mentioned Annual Reports in details, with the reasons of treatment based on the habits of the wormlets, and with the names of the observers appended; but the following notes of the main points are repeated as matter of convenience.

In regard to method of infestation and prevention of spread of it in the land.—A large proportion of the Eelworms leave the plants when dying and *drying* (as in Oats, for instance), and go into the surface soil, but some remain in the plants. To get rid of those in the land, common ploughing or digging is of very little service, it only disperses them about. But ploughing with skim-coulter attached, or trenching, will bury them well away. Those that remain in the plants will be in the stubble, or parts of the infested crop left in the field, or will be carried off in the harvested crop to be used for bedding or fodder. In the first case, as much of the stubble or remains of the infested plants as can be collected should be gathered together and burnt. With regard to what is carried from the land, it should be borne in mind that if it becomes mixed (as in litter, for instance) with manure, the Eelworms will in all probability be carried out again to reinfest the fields. It should also be remembered that they may be carried to an amount to do mischief in such surface earth of the infested field as may cling to the boots of workmen, or agricultural implements or garden tools. In this manner *patches of infestation* are very liable to be formed and spread.

All measures, whether of treatment of the ground or of liberal and rich manuring, of a nature suited to drive on hearty growth are of use in supporting infested plants if of material suited to its special nature, but nitrate of soda (so far as reports to myself go) has proved nearly or wholly valueless as an antidote to Eelworm-sickness.

Of special applications for Clover and Oats, whether as preventives, as manure in the preparation of the land, or as dressings to bring a crop over attack, sulphate of potash alone; as a mixture with sulphate of ammonia; or both of these with phosphates, have been found most serviceable.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in stopping the disease and bringing a good crop;—also at the rate of about ½ cwt. per acre it has done well.

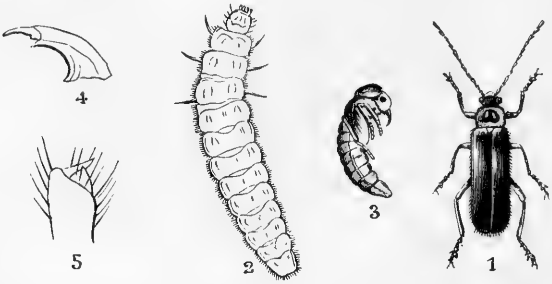
As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, brought remarkably healthy plants, with few exceptions.

A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones two parts: this at the rate of 1½ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness at Rothamsted, which I was kindly permitted to use, showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

A rotation such as will not give immediate succession of a crop liable to Eelworm injury to one which has suffered from infestation (as may be in the case of alternation of Oats and Clover) either at once or before sufficient time has elapsed for clearing the land of the wormlets, *is of great importance.*

BENEFICIAL INSECTS.—Soft Beetles; Soldier Beetles; Soldiers and Sailors. *Telephorus rufus*, Linn.; *T. clypeatus*, Ill.; and other species.



1, Telephorus clypeatus, magnified (size given below). T. rufus: 2, larva; 4, jaw of larva; 5, apex of antennæ, showing the two processes, much magnified (after G. R. Waterhouse). 3, T. fuscus, pupa (after De Geer).

It is somewhat difficult to place the infestation popularly known by the above English names under any appropriate heading, as the very common soft and carnivorous beetles are to be found on various kinds of flowers, and the equally carnivorous larvæ are also not limited in their locality; but some observation as to their *beneficial* habits in ridding us of small vermin is needed, as they are too often credited (so to express it) with causing us much harm. In the present case the heading of Clover is perhaps as appropriate as any, as it will be seen that the larvæ sent me during the past season were from Wheat sown after Clover; and on reference I find one species of *Telephorus* larva has been found so serviceable in destroying the maggots of a Plum Weevil in America, that very possibly we might find on research that our own *Telephorus* maggots also did good work amongst the maggots of our own Clover-leaf Weevils.

The *Telephorus* larvæ are long, somewhat slender, and parallel-sided; the edges of the segments well marked. They are black or very dark in colour, and may have reddish or white spots; the texture is velvety, and the head is exposed, and the abdominal segments rounded.

The beetles are of from about a quarter of an inch to half an inch in length, soft-bodied, long and narrow in shape (see above figure), and with flexible wing-cases, the horns (antennæ) thread-like, and legs long. They fly readily in the sunshine, and are to be found in spring on flowers, especially on those of the Whitethorn and of *Umbelliferæ*—that is, of the very many kinds of flowers growing in a many-stalked head from a central point, in the manner of Carrots and Parsnips.

What may be the reason for their bearing the popular name of "Soldiers" I do not know, unless it may be (quoting from Rye's 'British Beetles,' p. 141) that they are "warriors à outrance" (fighters to the death). They are described by Prof. Westwood as "very voracious, feeding upon other insects, and devouring such of their own species as they can subdue, the females not even sparing their mates." Also De Geer (see reference further on) notes having observed a female beetle in the act of holding a mate wrong side up with her feet while she gnawed an opening into its abdomen with her jaws.

For some years back inquiries have been sent me as to the (supposed) injurious habits of the beetles; but in the past season specimens of the larvæ were sent me on February 1st from near Faversham, with a memorandum that the observer was sending some sort of caterpillar that he had found eating his Wheat, which was sown after Clover. Information was requested as to what the creatures might be, with the further observation: "I have sown lime over the field to try and get rid of them" (F. N.).

As I was not able myself to make sure of the kind of larva sent, I submitted the sample to Mr. O. E. Janson, who replied that the "velvety larva" was undoubtedly a *Telephorus;* and further noted that only three or four species of *Telephorus* larvæ had been identified, and they were almost identical in larval stage, but my specimens agreed very well with the descriptions and figures of *T. rufus* given by the late G. R. Waterhouse in the first volume of the Ent. Soc. Trans.; "*fuscus* and *lividus* have also been described, and are very similar" (O. E. J.).

As the appearance of the larva or grub is so little known, I give Mr. Waterhouse's description at length, with the short but very valuable observation as to locality and date of feeding.

"*Telephorus rufus*, Müll.—*Larva*. Head coriaceous, pitchy black, furnished with two stemmata, one on each side close to the insertion of the antennæ. Body soft, of a dark brown colour, and very thickly covered with soft fine hairs, giving it the appearance of velvet.

"Length $7\frac{1}{2}$ lines.

"*Head* depressed, subquadrate, the basal half covered with a fine pubescence, of the same velvet-like texture as the body; the anterior half smooth. *Antennæ* with the basal joint short; second rather elongate, and containing two small processes partly within the apex. *Maxillæ* soft and fleshy, thickly covered with hairs, especially on the inner side which is bilobed. *Maxillary palpi* four-jointed, basal joint short; second moderate and cylindrical; third short and indistinct; terminal slender and acute. *Mandibles* long and acute, unidentate internally.

"Body elongate, slightly depressed, the joints nearly equal in width (taken longitudinally of the insect); the three first segments each with two impressed foveæ. Telum soft and unarmed, but with a fleshy protuberance beneath, which is used as a proleg. . . . This carnivorous larva is remarkable for having two processes, which spring from the second joint of the antennæ, instead of a single joint, as is commonly the case in coleopterous larvæ.

"It is found during the winter and spring months at the roots of grass and in decayed wood; it assumes the pupa state about the latter end of April, and the perfect insect makes its appearance in May." *

In De Geer's account of the habits of *Telephorus*, with descriptions of many of the species, given at pp. 57–79 of the 'Memoir' referred to below, † will be found at pp. 68, 69 his personal observations of the carnivorous habits of the *Telephorus* larvæ which he especially watched, both as to destroying each other, and also destroying earthworms placed in captivity with them, so that of the three earthworms under observation one was consumed, and the two others were attacked, and of various of the *Telephorus* larvæ nothing (beyond some remains) was to be found.

The surviving larvæ were found on May 28th to have turned to the pupal stage in the earth in which they were confined, without forming any kind of cocoon. The pupæ were about six lines in length, somewhat arched along the back, and the various parts of the forming insect plainly discernible; and during the month of June the development of the beetles (in this case *Telephorus fuscus*) took place from the chrysalids.

From the observation of Prof. Westwood that he had repeatedly found *Telephorus* larvæ creeping about footpaths, in moss, &c., in the winter and spring months, and also from the remark (p. 31, preceding) of my own correspondent that he found the grubs sent me amongst Wheat, it is presumable that they do us good service in clearing plant vermin both above and below ground, and more observations as to their habits would be useful.

It is mentioned by Dr. J. B. Smith ‡ that the larvæ "are especially effective against such creatures as the larvæ of the Plum *curculio* when they enter the ground to pupate, and a large proportion are thus disposed of annually."

The very common "soft" beetles bear a strong resemblance to

* See Trans. Ent. Soc. Lond., vol. i. p. 31, and Plate III. figs. $3a$ to $3g$. (Figure of larva, jaw, and extremity of antennæ at p. 30, preceding, are copied from these figures.)

† 'Mémoires pour servir à l'histoire des Insectes.' Tome quatrième. Second Mémoire, p. 57. Figures given at Plate 2 in same volume. Stockholm, MDCCLXXIV.

‡ See 'Economic Entomology,' by J. B. Smith, Sc.D., Entomologist to the New Jersey Agricultural College Experiment Station, p. 191.

each other, and the magnified figure of *T. clypeatus* at p. 30 is a fair guide to their general appearance. This species is more especially distinguishable by the thorax or fore body having a whitish margin, and a glossy black central spot; the legs and antennæ pale.

T. rufus is the same length as the above—that is, from a quarter to a third of an inch—and testaceous red in colour; the thorax spotless; eyes, wings, breast, and foremost segments of the abdomen at the base black.

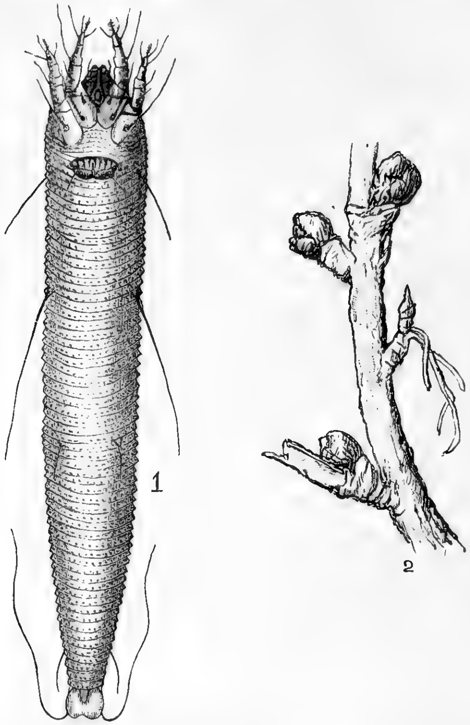
CORN AND GRASS.

In the past season the presence of Hessian Fly (*Cecidomyia destructor*) and that of Corn Sawfly (*Cephus pygmæus*) has not been reported as mischievous, otherwise almost all, if not all, the ordinary corn and grass insect infestations have been present. Daddy Longlegs (*Tipula*) attack was more than customarily reported; Wireworm (*Agriotes*), as matter of course, was troublesome; and the Common Cockchafer (*Melolontha vulgaris*) and the yet more troublesome Garden or Rose Chafer (*Phyllopertha horticola*), of which respectively the grubs are often seriously injurious at the roots of grass and other crops, were also present; and the Antler Moth (*Charæas graminis*), of which the caterpillars are at times devastatingly mischievous to large areas of grass in mountainous districts in the more northerly parts of England and southerly parts of Scotland, made some amount of appearance in Surrey.

Other attacks, whether to the blade, or the ear, the stem, or by distorted growth, as in the case of "Tulip-root" attack, caused by Eelworms, were present to a greater or lesser extent as usual, and are enumerated in the list given in the Preface. No additions of importance have, however, been made to published information of habits, or means of prevention and remedy, and it has seemed unnecessary to enter on these again. The reader is referred for details regarding them to their various names in the General Index to the series of Annual Reports which will shortly be issued.

CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS, greatly magnified; natural length of female 0·23 mm. (By permission, after Dr. A. Nalepa.) Black Currant twig with three buds affected by Mite Galls, and one bud unaffected.

Currant Mite Galls have continued to be as prevalent and to cause as much loss to growers as in previous years. The only methods of lessening the evil to some degree which appear to answer practically is that of breaking off the galled buds and destroying them.

Most careful and continued experiments at the Woburn Experimental Fruit Farm as to effect of chemical dressings, of which I was permitted to give the main points proposed in my Twenty-first Annual Report, pp. 154–158, were carried out, accompanied by microscopic examination at intervals to ascertain whether the Mites in the buds might have been destroyed by the applications without injury occurring to the growth of the buds themselves. This, however, I believe, was not found to be the case, and I only just allude (by permission) to the general result here, as I understand that a detailed report will be given.

At present (besides continuation of other experiments) observation is being made as to presence or non-presence of the *Phytopti* about the base of the stems of the Currants or in the earth round them. In this I am able to co-operate to some small extent, for during somewhat more than eleven years in which I have had the Black Currant bushes in my garden here (at St. Albans) under my observation, I have never found any presence at all of Mite Galls. Therefore it is fair to suppose that if the quite cut-down bushes, with the remains of the stumps and the adhering earth treated in various ways, which have been transferred to my garden from Woburn for special observation, should prove in the coming summer to be infested, that in this case the Gall Mites must have survived the treatment, and been conveyed on the stumps or in the earth.

Should (on the contrary) these cut-down and dressed plants continue free from infestation in the uninfested ground, and similarly cut-down and dressed plants in the neighbourhood of infested bushes at Woburn show the pest, it would point strongly to the Mites straying about, and this being one way of the trouble spreading.

For a long time it was said (and truly) that we did not know the history of the Mite, but, thanks to the observations of Dr. Nalepa, of Vienna, and Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester, this has long ceased to be the case; we know what the life-history of the Mites is on the bushes throughout the *whole of the year*. To what extent they may stray about on, or in, the ground at the roots of the bushes we cannot at present tell, but the regular life-history is as follows.

This *Phytoptus ribis*, which is the cause of so much mischief, is a Mite so small as to be invisible to the naked eye, and differing from the greater part of the families of *Acarina*, or Mites (which are eight-legged, except in their youngest condition, and more or less oval in shape), in being *cylindrical*, somewhat tapering to the tail, and having throughout the whole life *four legs*; the two pairs being placed beneath the body just behind the head or mouth parts (see greatly magnified figure, p. 34). Consequently on the action of these Mites within the forming buds (or close to them) as early as the beginning of June, when the leaf-buds are little more than a line, or the twelfth part of an inch, in length, the swollen growth is formed which we know only too well.

The history is as follows: Starting with the beginning of the year, the Mites may be found in January in the infested buds in perfect condition, and unaffected by even severe frost, beyond possibly making them somewhat sluggish; and in February egg-laying was found to have commenced on the 20th of the month, and eggs to be found in hundreds in company with the adult Mites. By March 6th there were "thousands of young forms (nymphs), eggs, and adults." By the 19th of April, and also at the date of examination in May, many of the galled buds were found to have opened, and to be dead and dried, and "those buds that were quite dead and dry . . . . were covered by the desiccated bodies of the Mites, and not a living example to be found amongst them."

Where the buds were completely dead and dry, as in the above instance noted on April 19th, it was to be expected that such of the Mites as had not left them should have died, and this leads on to the *observation* of the very important point of the *summer migration and settlement first by, then into, the young buds in their first growth.*

On June 2nd the new buds were found on the first half of the newly formed shoots, still only about a line in length, just protruding behind the leaf-stalk; and "between the base of the leaf-stalk and the buds at the ends of the young shoots," both adult and young Mites were found. No Mites were found at this date (June 2nd) *in* the young buds, and these occurred near the terminal buds only, and at this date only one of the old galled buds was found in a living condition, "and this simply swarmed with adult Mites."

On July 17th, Mites and many eggs were found between the leaf-stalks and the buds; and ten days later, terminal buds "were already *showing signs of being infested.* On examination, these were found to contain adults, nymphs, and eggs, nearly all of which were located in the centre of the buds. This was the first occasion I found the Mites within the newly formed buds" (R. N.).

Later on, that is, on September 13th, the new buds were much swollen, and measured up to as much as a quarter of an inch in length, and contained the pest *within them* in all its stages; but Mr. Newstead observed: "I could not, however, find any of the Mites behind the leaf-stalks as previously, so that I concluded they had taken up their winter quarters for good, and had set to work in earnest to ruin the crop of fruit while yet in the bud."

Thus we have observation, *at the intervals of examination*, of the presence of Mites in the buds from the last days of July, when the *first* infestation was observable in the *embryo* buds, round to June in the next year, when the infested buds and much of their Mite tenants are dead or dying, and the living Mites are migrating and setting up location between the forming buds and the leaf-stalks, as a preliminary to taking possession.

In the words of Dr. A. Nalepa, the especial observer of the *Phytoptidæ*:—"In the latter part of summer and in autumn the Mites leave the galls in multitudes to take possession of their winter quarters—that is, the buds. This emigration also is of frequent occurrence during summer when the previously inhabited buds dry up."

The above notes are abridged from the publications referred to in the foot-note.*

The great point calling for observation is the fact of *migration* at the date *which is shown* by the old galls which have fed their (so to say) "pestiferous" contents during the autumn, winter, and spring dying and drying, and the Mites (no longer being able to gain nourishment, and also in some cases their term of propagation and life being over) consequently also dying in very great numbers; whilst others, presumably amongst the adult Mites, such as were ready for, but not exhausted with, propagation, and also young Mites in incomplete stage, removing themselves by voluntary migration to the embryo buds, and beginning their arrangements for the next year's mischief.

The attention of readers is particularly requested to the above circumstances in regard to the statements somewhat idly made by those who have not taken the trouble to study the information published on the subject, that "we do not know the life-history." How we can utilize it remains to be seen, and as facts stand they show that what is *especially needed* is syringing that will lodge dressings, pernicious to the *Acari*, or Mites, in the axils of the leaves at the very time of all others when the ripening or ripened state of the fruit makes it most desirable that the bushes should *not* be meddled with in the way of being put under treatment. It also shows that the transference of the Mites is peculiarly liable to be assisted by their adherence to the clothes of the workers brushing about amongst the bushes where these are grown in areas of fields of many acres unmixed with partition bands of other bush or ground fruit or crop not liable to Mite infestation.

It is open to proof that breaking off the galled buds and destroying them *must* lessen amount of coming infestation; amounts varying from 1½ to 16 quarts picked off per acre speak for themselves, and *if much* benefit accrued, the cost varying from 3s. 6d. to 10s. 10d. per acre would not be of very great importance. But we want something better; the researches now going on may bring to light some unexpected method of lessening the trouble; but we have before us the absolute certainty that the method of growing Black Currants in close rows and large areas, from large quarters up to fields or acres in

* 'Die Naturgeschichte der Gallmilben,' von Prof. Dr. Alfred Nalepa, pp. 15, 18. (Erganzter Sonderabdruck aus dem ix Jahrsberichte des K.K. Staats-Gymnasium in Wien iv Bezirk.)

"Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5–7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

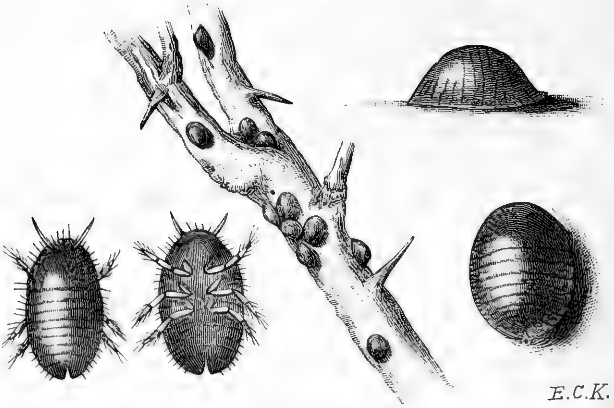
extent, and this on the same ground year after year, gives every accommodation and facility for the increase of the Mite pest that possibly can be.

There is more shelter, more breeding-ground, the spread of the infestation is not nearly so much under observation as where rows or plots of rows are accessible, and likewise during the weeks in the summer when the Mites are migrating there is great facility for their transportation in the plumage of birds and on the clothes of workers who move amongst the infested branches.

Where strips of other fruit bushes or crops are grown amongst the Black Currants it gives safety in many ways, and we know that the plan has been found to lessen the amount of mischief. My own view certainly is that where Black Currants are constantly grown in close rows of large breaks, or quarters, or by fields of acres, that it must be done at a deduction of percentage of labour for picking galls, besides losses on the crop, and great risk of extensive failure.

Currant (Gooseberry and Raspberry) Scale.

Lecanium ribis, Fitch.



Lecanium ribis.—Currant Scale, female, showing side and upper surface; larval Scales, with legs still visible: all magnified. Infested Gooseberry twig.

The Scale insect figured above, which from this autumn's observations may be now known as the Raspberry as well as the Currant and Gooseberry Scale, appears to be gradually spreading. For some years previous to 1893 observations were sent me of a brown Scale found to infest Gooseberry bushes to an injurious amount, and in that year the species was identified for me by Mr. J. W. Douglas, F.E.S., as being *Lecanium ribis*, Fitch. He mentioned them to me as being found on the Red and on the White Currant, but that (up to that date) he had not personally seen them or heard of them as infesting Black Currant.

In that year, however (1893), I heard of them from Mr. Wm. F. Gibbon, of Seaford Grange, Pershore, as being very destructive on Black as well as on Red Currants; and on careful examination of Black Currant bushes in my own garden, as well as in an adjacent garden, at St. Albans, I found it present on the boughs, although not to any great amount. On the Red and White Currant bushes it was very noticeably present.

Since that time little, if anything, has been reported about it until in the month of November in the past season I received from Mr. Walter J. Lavender, of Petersfield, a number of pieces of Raspberry cane showing very decided presence of infestation of fine specimens of female Scales, which he considered to be of *Lecanium ribis*. For the sake of obtaining certain identification, I submitted the specimens (on the canes) to Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, who was good enough to examine them, and informed me that the specimens were *Lecanium ribis*, Fitch, ♀ (=*L. coryli*, Linn.), and added:—"The specimens are unusually large, and in this respect approach *L. rosarum*. They are the first examples I have seen on Raspberry, and for that reason are interesting. The insect is undoubtedly a general feeder, for I have also received it on one of the Conifers."—(R. N.)

The female of this species of Scale is shown in natural size on an infested Gooseberry twig at p. 38; likewise in side and upper view, much magnified; and (likewise magnified) in larval state, whilst still in active condition, and possessed of six legs and a pair of horns.

On requesting any further information from Mr. Lavender which he might be disposed to give me regarding the attack in its new connection with Raspberry, he was good enough to write me on December 1st as follows:—

"It was certainly as early as February, 1897, that I first observed *L. ribis* upon Raspberry canes in this garden. The female Scales were then in all stages of development, varying in colour from almost light sienna tint to dark rich lustrous red-brown, so placed upon the stems as to the casual observer to appear excrescences upon the bark.

"Upon applying pressure with the thumb and forefinger, the lighter-coloured Scales exuded a perceptible moisture, and, removing the darker and harder Scales, they were found filled with the yellowish powder-like eggs described by you ('Handbook,' p. 111). . . . I failed to find the larva. I have since found the developed Scales at all seasons of the year upon the last year's growth of canes,—the fruiting canes of the year. I have not hitherto observed developed Scales upon canes of the year's growth.

"Yesterday and to-day (December 1st), since receiving the letter you wrote me, I have searched the canes of this year's growth, and have found what I think to be the larvæ before they have lost the power of locomotion.

"I send you as a specimen the whole cane cut off at the ground (severed into lengths for convenience of posting). I counted a dozen larvæ, which apparently are turning into the fixed stage, so closely placed together upon the cane as to cause the outer edges of the Scales to touch. When I first saw them there were many more, so disposed upon the young pale green tender bark as to give the appearance of a brown streak some five-eighths of an inch or more in length, and perhaps three-sixteenths of an inch at its widest, tapering away at each end to a few detached larvæ. Others were irregularly scattered about. The colour, a true chestnut, somewhat dark but bright ('Handbook,' p. 111); but they were very active, and gave me no opportunity of accurate measurement. . . . I have disturbed the bark as little as possible, the tear at the place where the larvæ were found being caused by my finger-nail in searching. Having found some, I did not look further, but send the whole cane to you.

"I suppose the fully-developed Scales having been found early in 1897 pointed to the infestation occurring at least in the preceding year? In my letter to you of the 7th or 8th inst., I attributed my not having found the Scale before 1897 to lack of observation."

In Mr. Lavender's previous letter he had mentioned that the Scale was "too plentiful upon the Red and White Currant bushes," and also present, though to a much less extent, upon the Gooseberries; and in his letter, quoted above, of December 1st he further observed relatively to this point:—

"With regard to the Currant and Gooseberries, the Scale is chiefly upon the under side of the branches, as stated by you ('Handbook,' p. 112),—upon the Gooseberries so much so that an ordinary observer, standing and looking down on to a well-grown, pruned, and open bush, would think it clean; but, on raising the branches, or, better, placing oneself in such a posture as to be able to see upwards through the branches, the infestation is seen in rows and small clusters, single file rows predominating.

"Yesterday, and for the first time, I found the Scale upon some *Black* Currant bushes. I am almost sure my Black Currant bushes have not before been infested. The Scales are perfect female ones, but not so fine as those sent to you upon the Raspberry canes."—(W. J. L.)

On examining the pieces of Raspberry cane referred to by Mr.

Lavender in his letter of December 1st, I found (on the 5th) Scales still in larval state. Some were scattered singly on the soft part of the bark; and in one instance there were a good many, perhaps seven or more, near together. These were of a brownish colour, and on placing several of them in glycerine, one showed itself to be quite in live condition by the active movement of its legs.

The female Scales of this species are hemispherical in shape, of some shade of brownish yellow, or nut, or rich brown colour, and sometimes slightly curved outwards at the lowest edge, and the margin finely wrinkled transversely. The size variable,—in the case of the Currant Scales described by Dr. Asa Fitch, of Albany, U.S.A., about 0·30 (that is, about three-tenths of an inch) in diameter. In the specimens which I examined, taken from Gooseberry bushes in my own garden, the size ranged from an eighth of an inch to rather more; the width about equal to the length; the height about one-twelfth of an inch or rather more in the middle. The general surface was so irregularly varied according to age and condition as to make it impossible to give a precise description.

The maggots, or larvæ, were so small as to be almost invisible to the naked eye, narrowly oval in shape, with six legs, and a pair of horns (see much magnified figure, p. 38). The colour varied much, from some shade of ochrey to puce or reddish, the body was somewhat raised along the middle so as to form a slight keel, and the abdomen of the larvæ as well as the female Scales showed a more or less noticeable caudal cleft.

In regard to the life habits, it appears to me that we may find the Raspberry less liable to very injurious presence of attack consequently on the upright growth of the canes throwing the infestation much more open to weather influences than in the case of Scale presence on Gooseberry and Currant, where much more shelter is afforded by the branches.

On March 10th (1893), when I found both females and larvæ of this *L. ribis* very prevalent on Gooseberry bushes in my garden at St. Albans, the female Scales were numerous on the old wood, *and mainly beneath the branches, where they were sheltered from weather*, and where the bark was often split or peeled away so as to expose the under surface; but (*up* to that date) the infestation was not noticeable on shoots of the preceding year's growth.

In the notes of habits of the Scale sent me by Mr. W. F. Gibbon, of Seaford Grange, Pershore, as the result of the observations of one season verified by those of the next, he remarked that the young Scale emerged from the egg early in the spring; he found them hatched out early in February, and walking with freedom on their six legs. At first they were almost transparent, but they soon became of a chestnut colour, and assumed the shape of a small wood-louse, and then secured a position by inserting their beak into the bark, and speedily increasing in size.

"When about three-fourths grown their covering appeared very shiny and sticky, and, later on, dry and harsh. In May I found the Scale matured and eggs deposited, and on the 18th of June the eggs hatched, and the young *are now*" [July 15th, E. A. O.] "on the move, and it is at this stage of their existence to apply washes for their destruction. The young now wandering about will soon affix themselves to the bark, assume a hard covering, and mature; by autumn deposit eggs, which will hatch next spring. There are consequently two generations in a year."—(W. F. G.)

Mr. Gibbon mentioned this species of Scale being very destructive.

In my own observations I found on June 6th female Scales, in most instances full of eggs, on some Gooseberry bushes which had not been much attended to, and by the end of July I found multitudes of young Scales had been hatching, and were noticeable on a bough which had been brought under cover, although on Gooseberry branches exposed to weather, insect attack, &c., out of doors, there was little larval presence to be seen, although there were plentiful remains of egg pellicle.

It should perhaps be just alluded to for those not acquainted with the life-history of Scale insects, that the brown shiny skin is not the real female, but the coat beneath which she has changed from the early stage to what, to the naked eye, appears a mere lobed, fleshy, greyish lump, containing or surrounded by, according to condition, innumerable quantities of eggs, so minute as to fall, on disturbance, like a shower of white dust.

Prevention and Remedies.—In regard to checking attack on Raspberry canes (the locality of infestation which has not previously been brought forward) one desirable method would be to cut down the bearing canes of the year as soon as is reasonably possible after the fruit has been cleared. Thus a great amount of the female Scales would be got rid of from the beds, and might be easily destroyed by burning those canes *which have fruited.* We have not observations as yet of the *female* Scales being found on the canes of the current year's growth (those that would furnish the bearing shoots of the following season), only of the larvæ, the still active Scales in very young state, being found on these, and conjecturally the specimens found will have strayed from what may be described as the family headquarters on the bearing wood.

So far as I am acquainted with the habits of this species, it appears to me to be unusual that the larvæ should be observable in active life at the date at which they have been now observed, namely, the beginning of December. This date appears to be too late (in regular course) for the summer brood, and too early for the winter or early spring brood, which hatches (see p. 41) in February. Possibly the mild season may have made a difference, but unless the species when on Raspberry customarily occurs thus in larval state at the end of November or beginning of December, the practice of clearing the *fruited* canes with their infestation might be expected to keep it well down.

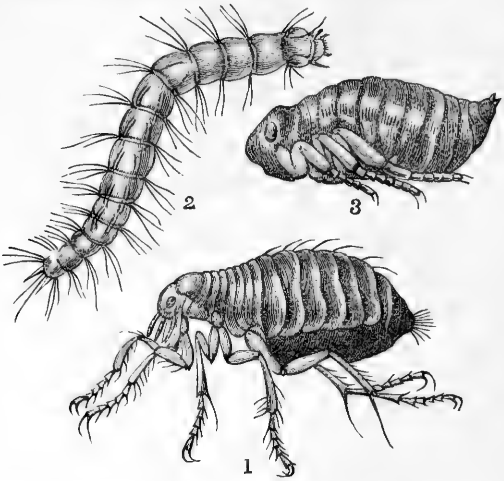
For prevention of attack in the ordinary cases of infestation on Currant and Gooseberry, the date of winter pruning is very important. It is desirable that this should be done, and the Scale-infested boughs cleared from the bushes, and also from the ground where they fall in pruning, *and burnt* before the time when the larval Scales will be hatching and dispersing themselves about bushes. *It should be done quite by the commencement of February.* Also it is desirable, after the prunings have been gathered up, to *stir the surface* of the soil under the bushes, and to throw a little quick-lime, or any preventive mixture preferred, on the soil just round the stems to prevent the little Scales making their way back to the branches.

Currants trained on walls require attention, and perhaps a rod occasionally taken out, down to the root. In my own garden I have found the Scales in patches at intervals on a length of several feet of White Currant.

Looking at the manner in which the Scales shelter under ragged bark, and also (especially in the case of Gooseberry bushes) on the under side of the branches where these are thick enough to protect them from weather influences or other enemies, it is obvious that attention should be carefully directed to these points, both by pruning off old rough boughs where this treatment is allowable, and by spraying, and also by running soap wash on and down the infested boughs, so as to lodge in the rough bark and kill the tenants. Probably any of the common soft-soap washes, especially those that are mixed with sulphur or mineral oil, would be of use; and in communication with one of my correspondents he mentioned that he had found "Chiswick Compound" very effective in destroying Scale on his infested Gooseberry bushes. This mixture is procurable from the Chiswick Soap Company, Chiswick, Middlesex, and probably it would be as serviceable an application as could easily be found, as it is a mixture of soft-soap and sulphur, which act well against these kinds of bark infestations, and it has the advantage of the sulphur becoming soluble (so as to be completely mixed with the wash) in from sixteen to twenty-four hours after the requisite amount of *hot* water to dilute the mixture to a safe strength has been added.

FLEAS.

House Flea. *Pulex irritans*, Linn.
Cat and Dog Flea. *Pulex serraticeps*, Gerv.



PULEX IRRITANS, larva, and pupa—all much magnified.*

On September 22nd, in the past season, my attention was very urgently directed to an outbreak of what on examination proved to be male and female Fleas, but in such numbers and so pervading the district reported from, that our common house and domestic pests had not been recognised. On mentioning the occurrence to another correspondent, information was sent me of the appearance of similar annoyance, although not on such a great scale, in other localities, these infestations presumably being all due to the long drought, which left the haunts of Flea *maggots* round farm or homestead in the dry condition most favourable for their feeding and progress, instead of this being checked, as in common seasons, by ordinary rainfall and plentiful supply of water being available to wash their lurking-places, respectively out of doors or under shelter, into a state wholly injurious to them.

Most of us are well acquainted with the common Fleas as minute, flattish, brown, shiny insects, blood-sucking in their habits, and with the power of taking tremendous leaps. But very few in comparison know that the Flea in its early condition is as different from the perfect insect as a fly maggot is from a fly. It is a slender, whitish,

* From figure 76, p. 141, of 'Insects Affecting Domestic Animals.' U.S.A. Department of Agriculture, Washington. 1896.

footless larva (see figure, p. 44), with a pair of horns, and a pair of biting jaws, and is to be found in dry places, as (in houses) on rugs, or cloths, or carpets, or any similar dry localities, where the eggs from Flea-infested animals lying on them fall, and where the maggots feed on the fragments of the various kinds of *dry* material to be found. There they change to the chrysalis state in a cocoon, from which the Flea soon emerges, and (necessarily) where the conditions have been peculiarly favourable for the growth and development of the larva, there will be peculiarly great presence of Fleas, and they will spread intentionally or accidentally so as to be really serious inflictions in the district.

On September 22nd the following account of such a visitation was sent me:—

"One of the villages I have visited, . . . *viz.* the village of Haslington, I found was literally swarming with the enclosed insects; cottages, fields, especially a large farmhouse (the inmates, it may be mentioned, being scrupulously clean); these insects were found in thousands in the house, bedrooms, personal clothing, as well as outside, really in small colonies; better class as well as the poorer being alike troubled."

Inquiries accompanied as to the nature of the insect, reason of its presence, and means of getting rid of it, with the further remark:—

"All ordinary means have been used in the farmhouse which I allude to with no success. This plague (for so it appears to be) commenced about five weeks ago all at once, and shows no signs of diminishing. I should be glad to know your opinion on the subject, with the remedy, in order to make this known as soon as possible." *

On November 30th, Mr. P. Hedworth Foulkes, of the College, Reading, writing to me on the subject of the above Flea infestations, observed:—

"I heard just before coming back to Reading in September of a similar plague in North Wales. Two or three houses belonging to people in good position, as well as houses belonging to artisans, were quite suddenly found to be swarming with the pest. There seemed to be no reason to account for their sudden appearance. One house was nearly two miles from the town, and the nearest dwelling three-quarters of a mile away. In another case three houses in a block were suddenly found to be practically swarming."—(P. H. F.)

With regard to similar infestation (though not on such widespread scale) I can speak from personal remembrance of Flea presence in the buildings of a farmyard that I was acquainted with for many years of my life, where a large covered poultry house and other covered

* In this case I have not given my contributor's name, as I am not sure that he wished me to do so.

buildings, well adapted for *dry* shelter and nurture of Flea grubs, ranged continuously along one side of the yard. The Fleas which swarmed occasionally about the place were little less than a visitation.

A great plague of Fleas is sometimes accommodated in such places as the hassocks of a large church or cathedral, where there are free sittings, or in the matting of a library, where circumstances are more in favour of their taking possession than being removed. In the case of the hassocks, I have known a periodical cleaning to disclose such armies of the parent Fleas making their way from the disturbance of their hassock head-quarters being beaten in the churchyard, that there can be no reason for doubting that much of the future Flea supply would have been found housed there if investigation was made.

In the case of infested matting, an instance was given me of presence of the plague in an old school or college library. In this case it was only on raising the matting that the insects were discovered. They appear to have been the common Flea, and the workmen were the people who suffered. As the room was being cleared out to be used for another purpose, the matting was destroyed, having been down for about five or six years.

Besides the numbers of published instances on record of Flea grubs and eggs being found on rugs or dry places where infested household animals habitually lay (even to half a teaspoonful of Flea eggs being collected from a lady's dress who allowed a much-infested "pet" to make her lap into its bed), I have known much commotion caused by a quantity of "something" being found on the top of a small ottoman where a house spaniel spent much of his time, and which proved to be Fleas in egg or grub state, but, as so very often is the case, not known to be such.

The following account of the group of insects commonly known as Fleas, in this case scientifically classed as *Siphonaptera*, extracted from the U.S.A. publication by Prof. Herbert Osborn noted below,* is given as a reliable condensed account of the characteristics of the group and its life-history brought up to date:—

"The insects of this group are characterized by the entire absence of wings, by having the bodies compressed, the legs long and stout, the coxæ† being remarkably developed, giving them great leaping power. The mouth parts are well developed, and adapted for suction, all the species in the adult stage feeding upon the blood of mammals

* 'Insects Affecting Domestic Animals' (species of importance in North America), p. 141, by Herbert Osborn, Professor of Zoology and Entomology, Iowa Agricultural College, U.S.A. Department of Agriculture, Division of Entomology, Washington. 1896.

† *Coxa*, the hip; the chief division of the legs of insects, between the *femur*, or thigh, and the *thorax*, or fore body.

or birds. The antennæ are small, usually sunken in a pit or groove in the side of the head, and of peculiar form, the third or terminal segment being annulated, or, in some cases, even divided into leaf-like plates. The eyes are simple when present, but in many cases they are reduced to mere rudiments, or even completely wanting. The tarsi are five-jointed.

"They undergo a complete metamorphosis,* the early stages being passed in places adjacent to the resorts of the host. The eggs, while sometimes laid upon the hairs of the host animal, are loosely attached, and must ordinarily be scattered in places where the host-form sleep or nest. The larvæ, so far as known, live in dust or litter in similar locations. They are slender, worm-like, footless objects, with a sparse covering of hairs. The pupæ form in similar locations, enclosing themselves in cocoons. Westwood says:—'When full-grown, which occurs in summer in about twelve days, the larvæ enclose themselves in a small cocoon of silk, often covered with dust, and attached to surrounding substances. Rösel, however, observed that some of the larvæ underwent their transformations without forming any cocoon.'" —(H. O., in work quoted.)

The author further observes that, though Fleas are parasitic in the adult stages, they are not strictly confined to the host animal, but wander from it at times, and may even be found on different species of animals from those which are evidently their regular hosts.

The following further points of interest in the Flea life-history, taken generally, are extracted from the very useful book mentioned below †:—

"The little Fleas are simply the males, which are considerably smaller than the females. . . The males also differ in shape, and have the hinder end of the body somewhat turned up." In Mr. Butler's figures of a male and female Flea, plate v. of his work referred to below, this difference in size and shape is very well shown. The female Flea in the figure at p. 44, at heading of this paper, shows the oval form of the extremity of the abdomen well, corresponding in shape with the photographed figure by Mr. Butler; in the male, as also shown in the figures by Mr. Butler and Dr. Taschenberg, the lower part of the abdomen and appendages is turned up so that the extremity forms a kind of terminal mass on a level with, or rather higher than that of the line of the back of the abdomen, and divided from it by a deep notch. The figure at p. 48 of the Cat and Dog Flea gives some idea of this form in much magnified detail, and the

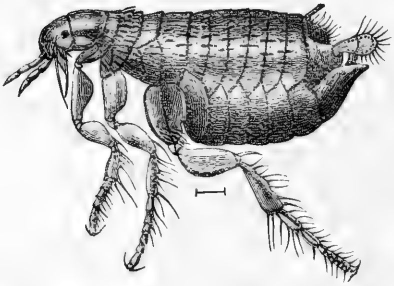
* That is, they are *not* (like Grasshoppers and some other insects) almost similar in general shape throughout all their stages.

† 'Our Household Insects,' chap. xiv., by Edw. A. Butler, B.A., B.Sc. London: Longmans, Green & Co.

difference of shape was very observable in the specimens sent me last autumn. See p. 44.

Of the habits of the House Flea (*P. irritans*), quoting from various observers, it appears that the larvæ, or maggots, attain full growth in about eleven or twelve days, and occupy about twelve more days in maturing in pupal state, from which the perfect Flea develops, at first as whitish in colour, but soon assumes its brown colour. In winter, the time of development, even in a warmed room, is somewhat longer.

The Cat and Dog Flea (*P. serraticeps*, Gerv.) may be distinguished from the House Flea (*P. irritans*) by the presence of "combs of spines



Pulex serraticeps, magnified, and line showing natural size.

on the border of the head and pronotum" *; a comparison of the edge of the head and of the segments behind the head in the figures of Fleas given at p. 44 and above will show this difference clearly. This kind is said to be generally distributed, "practically over the entire world"; but as in general appearance (to mere examination by the naked eye), and also in habits, it much resembles the House Flea, it seems unnecessary here to go into minutiæ.

There are various other kinds, as *Pulex avium*, Tasch., infesting many birds, including domestic poultry; *P. fasciatus*, Bosc. d'Antic, or Rat and Mouse Flea; *P. sciurorum*, Bouché, infesting squirrels (in Europe); *P. goniocephalus*, Tasch., and other species, which are not now (though they formerly for the most part were) included in the single family of *Pulicidæ*, which has now been more specially restricted to the forms "in which the female abdomen does not become swollen, and the labial palpi are from three- to five-jointed." †

In the above notes I have tried, to the best of my power, to give some main points of information brought up to date, and which may, I trust, be found reliable. But those who search the accounts generally referred to will appreciate the great difficulty of reconciling many of the statements, not only as to position of the family and its

* *Pronotum*, the upper part of the prothorax—that is, the foremost division of the fore body.

† See 'Insects Affecting Domestic Animals,' previously referred to, p. 142.

recent division, but also in respect of nomenclature of species, habits, and means of prevention.

Prevention and Remedies.—The following observation on "destruction of Fleas" is taken from the work mentioned below*:—

"To destroy those of Dogs, insecticide powders which have for their basis the flowers of pyrethrum, stavesacre, or wormwood, are sprinkled over the animal, so as to fall between the hairs; or the skin may be rubbed with common or laurel oil, with which a little powdered tobacco" [care should be taken as to amount of tobacco, or much harm may be done to the animals, E. A. O.] "has been mixed, and a soap-bath given twelve hours afterwards. Some people are content to use sulphurated, benzinated, or creolined water, or powdered parsley or wormwood.

"Cleanliness, baths, washing with potash, carbolic, or cresylicated soaps prevent the multiplication of Fleas. Kennels or other places invaded by these creatures should be treated with boiling water or limewash.

"Pine shavings have been recommended as bedding for Dogs, with a view to keep away Fleas. It has also been recommended to have the floors of kennels made of the staves of old tar barrels, laid edgeways between the stones. The persistent odour of the tar does not hurt the Dogs, and it drives away the Fleas. The same result is arrived at in sprinkling on the floor creoline powder, or creolinated water, five or ten per cent.

"For poultry, the same measures may be adopted, or those prescribed for lice."—(L. G. N.; trans. G. F.)

Remedial dressings, however—as, for instance, of pyrethrum, or even sprayings with benzine—do not seem always very certain in their action; and, failing these, the simple and effective method advised by Dr. L. O. Howard (Entomologist of Board of Agriculture, U.S.A.) is to *take up all floor coverings and wash the floor with hot soapsuds.* This treatment can easily be carried out in the matter of application of a good supply of hot soapsuds to many cases besides house floors; dog-kennels, hens' laying-boxes, the floors of hen-houses, and outhouses of all kinds may thus be cleared. Good application of moisture, and also taking care that fowl-runs are where the ground is open to rainfall, have been found to answer well.

Put shortly, the fact of the eggs and grubs being found in situations where they are not liable to be much disturbed, as in dust in chinks in floors, in, or on, or under carpets, matting, door mats, cloths, &c., is the point to work on; and besides all applications in the way of

* 'Parasites and Parasitic Diseases of Domesticated Animals,' p. 61, by L. G. Neumann; translated by G. Fleming, C.B., &c.

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dressings (and very especially of hot soap and water), a thorough use of the broom, and good shakings of all things which serve as resting-places for domestic animals, and throwing all gathered-up sweepings into the fire, will go far to keep the dwelling-house free of these disturbing pests.

FOREST FLIES.

Forest Fly; Spider Fly; Forester. *Hippobosca equina*, Linn.

Hippobosca equina: 1 and 2, natural size and magnified from life; 3, pupa removed from egg-like puparium (after Réaumur). Puparium, natural size and magnified, before complete colouration.

The Forest Fly is referred to again this year relatively to observations having been contributed of its presence, to an extent to cause serious inconvenience, in a district of Glamorganshire and the adjacent part of Brecknockshire, thus adding a new locality to those previously known to be infested.

Up to the year 1895, when the circumstance of the autumn military manœvres having been arranged to take place in the New Forest in Hampshire drew considerable attention to annoyances which might occur from this exceptionally troublesome horse pest, this fly was considered, except (I believe) some report of its presence in Dorsetshire, to be wholly confined in this country to the New Forest or its vicinity.

So far back as the year 1781 this species was recorded as being found in great numbers in the New Forest, and as being a great pest to horses and cattle; and the "New Forest Fly" has been one of its special names. Specimens from the New Forest, and likewise from Dorsetshire, are in the entomological collections in the British Museum of Natural History, South Kensington; and in 1895 I received specimens from the valley between Beddgelert and Portmadoc in North

Wales. Since then no definite record has been sent of infestation in other districts until in the past summer I received a plentiful supply of specimens from Dr. D. Thomas, Medical Officer of Health of the Pontardawe Rural District Council in Glamorganshire, with information of the flies being a troublesome infestation in a district of which various places were named lying some miles in a westerly and northerly direction beyond Neath.

The first communication was sent me on August 17th by Dr. D. Thomas, from Tyr-waun, Ystalyfera, Glamorganshire, as follows:—

"I take the liberty of asking your opinion on the enclosed specimens of what are known in this district as 'Forest Flies.' They are a perfect terror to horses,—some animals becoming quite beyond control. Fortunately, according to my experience, they are not very frequently met with. I have generally found them in the parish of Ystradgynlais, in Breconshire, among hillside farms, where there is plenty of scrubby timber."—(D. T.)

The specimens sent proved beyond doubt to be *Hippobosca equina*, Linn., and on mentioning to Dr. Thomas that (the matter being of much interest) I should be very glad of a few more, he wrote me, on August 20th, that the next time he was in the locality he would do all he could to procure additional specimens; also he remarked: "I only wish I could extirpate the whole tribe, for a more terrible nuisance to some horses I have never known."

About three weeks later (on September 9th), Dr. Thomas forwarded me six or seven more specimens, which, on examination, all proved to be of *H. equina*, with the observation: "I am able to send you to-day a few more 'Forest Flies,' and being alive I have put them in a match-box. These were caught on a hillside farm near Crynant Village, about four miles from Neath, Glamorganshire. It is getting a little late in the season, but next year, if you should require any more, I dare say you can have any quantity of them."

The specimens sent me I shared with Mr. O. E. Janson, F.E.S., as I was desirous that examples of presence of *H. equina* in this previously unrecorded locality should be in the collections of a well-known entomologist, as well as in my own; and subsequently Mr. Ernest E. Austen, of the Zoological Department of the British Museum of Natural History, South Kensington, wrote me that, through the courtesy of Dr. D. Thomas, he also had received a supply of specimens for the collections in the British Museum, so that the presence of this truly undesirable horse and cattle pest, *Hippobosca equina*, Linn., in the *south* of South Wales is now thoroughly recorded.

In a geographical point of view it may be worth remark that all the localities of Forest Fly (that is, of *H. equina*) that we are at present acquainted with in this country are not far from the sea. The

New Forest occupies much of the south-west portion of Hampshire. I am not aware of the precise locality in Dorsetshire from which the specimens in the British Museum were procured, but the whole of Dorsetshire lies along or near the English Channel. Glamorganshire lies the most to the south of any of our Welsh counties, and has a long sea frontage; and the localities of the Forest Fly mentioned by Dr. Thomas, namely, Ystalyfera, Crynant, and Ystradgynlais, lie not far from Neath (their position is found without difficulty in the map showing railway stations in Bradshaw's 'Railway Guide'), and Neath is only four miles from the mouth of the river of the same name.

In the case of the North Welsh observations, the neighbourhood in which the Forest Flies were found was the wide valley running from Beddgelert, at the foot of Snowdon, to Portmadoc, a small *seaport* town in Carnarvonshire (in the parish of Ynyscynhaiarn), eight miles distant. Here ponies are kept on the mountains on both sides of the valley in the summer, and a herd of ponies on the lowland both summer and winter, and there is much horse traffic along the road which runs beneath the Snowdon mountain. The Forest Flies were noted as being only seen in the district from the beginning of June to the middle of September, and the specimens sent me were captured on one of the horses of a coach plying between Portmadoc and Beddgelert, and forwarded on June 26th. The specimens and observations were sent by Mr. W. Morris Williams, of Pwlheli, in reply to inquiries sent by the editor of the 'Veterinary Record' to all the members of the Royal College of Veterinary Surgeons in Carnarvonshire as to localities in which "Forest Fly" was to be found.

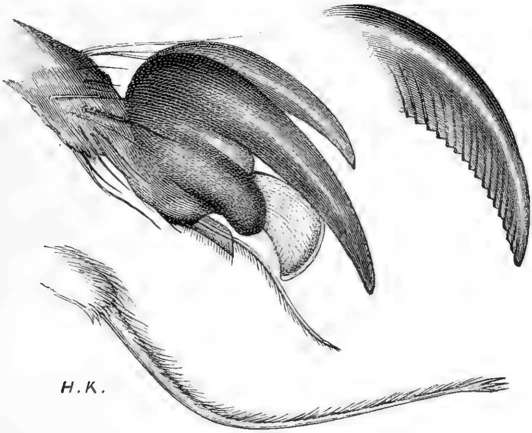
The Forest Fly, when at rest with the wings laid flat on the back, as figured life size and magnified at p. 50, is three-eighths of an inch in length from head to the extremity of the wings; about a quarter of an inch in length from head to tip of tail. The shape is flattish, and the skin so hard and leathery that it is difficult to crush.

The head is tawny yellow, with a dark stripe down the middle of the face; the compound eyes dark and very large, occupying the whole sides of the head; ocelli, or simple eyes, *wanting*. The *thorax*, or body between the wings, has on each shoulder a large patch or irregular ring of tawny yellow, with more or less of the brown ground colour in the centre, some small pale markings along the middle of the hinder part of the thorax, and *a pale spot in the centre of the scutellum* (that is, of the small portion of the upper part of the thorax just preceding the abdomen). The abdomen is brown, grey below, and, like most of the fly, more or less beset with bristly hairs.

Wings two, strong and membranous, slightly opaque and brownish in colour, and furnished with several strong dark veins placed along the front portion, as exactly figured from life at p. 50.

Legs rather long (when extended flatly, they appear very long), of great strength, and tawny yellow in colour, variously ringed, or clouded, or otherwise varied, with brown or black.

Each foot (or *tarsus*) is terminated by a pair of claws, each of the pair being formed of one large, very strong, much curved, black claw, at the outside of which is placed another much shorter and thicker, forming a kind of thumb-like appendage to the main claw. See figure below. On placing the curved claw in a good light, it can be seen



Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata* (also magnified), showing parallel grooves and saw-edge.

(with the help of magnifying powers) that the lower parts of the sides are furrowed by minute grooves placed parallel to each other, and that the lowest part of the claw has, running beneath it, a regularly serrated, or scalloped, edge, each groove running down to a notch in the saw-like edge. This structure I have also observed in the Indian Forest Fly, *Hippobosca maculata;* see figure accompanying of *portion* of a curved claw very much magnified. Consequently on this peculiar structure, when the fly presses the sides of the curved claws together, they form a kind of flat-sided forceps, perfectly adapted for holding fine objects like hairs, amongst which the presence of the infestation causes exceeding discomfort, or with horses unaccustomed to it quite uncontrollable terror.

Beneath the foot and between the cushions, or pulvilli (see figures above, greatly magnified), is a long stout hair, or rather bristle, extending fully to the length of the curved claws, and bearded with side hairs. The appearance of this appendage varied much according to the circumstances under which it was observed; when seen in natural condition, being well described as a "somewhat plume-like body," but when examined in Canada balsam, instead of the whole length of the many hairs placed along the fine bristle being observable, only their lower portions were noticeable, the bristle thus having the appearance of being beset by fine spikes. The terminal extremity was not pointed, but ended in about five spines, or moderately sharp spine-like tubercles.

In the course of my observations on the method of movement of Forest Flies and their power of adhesion to upright surfaces, such as the sides of a cardboard box, I found that (when observed by hand-magnifiers of two-inch power) they did not appear to make any use at all of their strong curved claws to help them up the ascent. The claws were thrown up and somewhat back, so as to be clear from any attachment at all, and the fly progressed upwards to all appearance holding by the thick basal portion of the claws only. On investigation I found (at this spot) an appendage, invisible without high magnifying power, which does not appear to have been previously observed, and which, when displayed, proved to be a thin flat membrane, down the centre of which ran a vein, or tube, curving from each side of which were a series of channels, or ridges, running to the edge of the membrane, about twenty in number on each side. This formed a thin flat plume-like flap, at the base of which was a bulb-like formation, thickly covered with hairs.* The general appearance of this membrane bears (at first glance under a high magnifying power) a great resemblance to the flexible lobes known as *labellæ*, which form the terminal portion of the proboscis of the Blue-bottle Fly.† In these labellæ the side tubes (which it is noted by Mr. Butler are called *pseudo-tracheæ* on account of their superficial resemblance to tracheal tubes) differ somewhat in disposition from those in the apparatus in the Forest Fly's foot, as in this case the series on each side starts from the central vein or tube,—in the proboscis of the fly each side series starts from a separate longitudinal tube or vein; but beyond the external appearance, which is given in my two plates referred to in the note, I am not aware of the structure of this part of the foot apparatus of *H. equina* having been entered on.

The *Hippoboscidæ*, to which family the Forest Fly belongs, are distinguishable by not existing *actively*, except in imago state—that is, perfect or fly state. The egg is hatched, and the maggot, or larva, feeds and is nourished up to maturity in the abdomen of the female fly, and when fully developed is deposited, and the change to pupal condition (in all ordinary external characteristics) takes place so

* In my Nineteenth Annual Report two plates are given, in which the foot of *H. equina*, with the claws and the various appendages, will be found magnified; one of these plates is repeated now as frontispiece.

† See figures, much magnified, given in plate ii. of 'Our Household Insects,' by Edw. A. Butler, B.A., B.Sc.

immediately that the name of *Pupipara*, or "pupa-bearing," has been bestowed on this division of the Diptera. This fully-developed larva (or puparium), which is very often mistaken for the egg of the fly, is white when deposited,* and, in the case of *H. equina*, so rapidly changes in appearance, that in twenty-four hours or less it has become brown or black, and hard outside, and from this chrysalis, or pupa-case, the fly emerges by cracking off one end of its case (customarily) in about four weeks, though it is considered that hybernation sometimes takes place in pupal state.

In regard to some main points in the habits of the fly. From observations taken in the New Forest it appears that these may be found fairly plentiful early in May, when warm sunshine has brought them out from their winter quarters in sheltered places or under bark of old trees. On wild ponies or cattle in the Forest these flies may be in clusters of even hundreds without the animals appearing to mind their presence so long as the flies remain at rest.

The great trouble is in the case of horses unused to the fly attack, which on first infestation by a Forest Fly "have a frightened look, lay the ears back, make short stamps and kicks with the feet; and, if the fly is not taken off, will sometimes kick violently, and even roll." The difficulties from horses unaccustomed to the fly becoming unmanageable on their first acquaintance with it are well known. This fear does not appear to arise from any pain connected with the bite, though the flies are to some degree blood-suckers, as is shown by flies being sometimes found distended with the blood they have taken, and much of the distress and terror is ascribed to the irritation caused by the fly running (generally sideways) amongst the hair, and also by means of its groove-sided claws having such hold of the hairs that the horse is totally unable to dislodge it. With this fly, as well as with one of the Indian kinds, the Dog Forest Fly, *Hippobosca canina*, the tenacity of the grip of the claws on hair is so great that it can peel the outer part of the hair to mere shavings, and the dragging that must take place at the roots of the hairs in the passage of the pest amongst them may well account for the distress on its first experience.

Nothing (so far as I am aware) has been mentioned as to the effect of its peculiar cry as it settles down, but from my personal experience when attacked by a stray specimen in my study, when I was unprepared for its sudden flight at my hair, I should say that the noise was thoroughly startling.

One of the most commonly adopted remedies for attack to unseasoned horses in the New Forest is to damp a cloth with paraffin,

* For figure, natural size and magnified, before complete colouration, and for figure of pupa removed from puparium, see p. 50.

and rub lightly over the animal, particularly the parts beneath and under the tail, which are most subject to infestation.

In the above notes I have only entered shortly on some of the main points regarding this infestation, which I have given in detail at pp. 95–117 of my Nineteenth Annual Report. In this will be found my own observations on the elaborate structure of the foot appendage, and many notes from life regarding habits of the fly and remedial treatment used in the New Forest, as well as abstracts regarding the existence *in embryo* from the observations of Réaumur, and references, confirmatory observations of De Geer, and references to the elaborate considerations of Leuckart, and notes from other entomologists. There I have also given some observations on the Dog Forest Fly, *Hippobosca canina*, Rondani, also of the Indian or Spotted Forest Fly, *Hippobosca maculata*, Leach, which were placed in my hands in the course of the investigations of 1895, and are of considerable interest as being of nearly-allied *Hippoboscidæ*.

Spider Fly; Grouse Fly.

Ornithomyia avicularia, Linn. (= *viridis*, Meigen).

On September 29th I was favoured by Mr. E. G. Wheler, of Swansfield House, Alnwick, Northumberland, with a specimen of a "Forest" or "Spider" Fly taken from a grouse, with the remark accompanying that he forwarded it, as it might be of interest relatively to some difference which he noticed in the structure of the claws of the specimen and those of the nearly-allied Horse Forest Fly, *Hippobosca equina*.

From the wings of the specimen being folded longitudinally under the covering glass of the microscopic slide, it was not possible to investigate the neuration thoroughly, but other characteristic points were so well displayed that (after consultation) there did not seem to be room for doubt that the specimen was *Ornithomyia avicularia*, Linn., sometimes also known as *viridis;* this, more especially as *O. avicularia*, L., is the only species recorded as British in the 'List of British Diptera' by G. H. Verrall, F.E.S., 1888.

On October 25th, in reply to my mention that a few more specimens would be very acceptable if easily procurable, Mr. Wheler was good enough to send me two more, preserved in spirit, with the observation :—

"I have no opportunity of obtaining more Grouse Flies now, and, in fact, think it very probable that they are only about during the hot weather, as they are very active, and by no means easy to catch when they leave their host. . . . I took the Grouse Flies from freshly-killed birds when driving early in the season. There appeared to be generally two or three on each bird."

Ornithomyia avicularia is of the family of *Hippoboscidæ*, but is distinguishable by several easily observed points from *Hippobosca equina*, noticed in the preceding paper. For one thing, it is about one-quarter less in size than *H. equina* (Horse Forest Fly), which is from three and a half to four lines long, whereas *O. avicularia* (Grouse Fly) is from two and a half to three lines in length. Also, in addition to the compound eyes possessed by both species, *O. avicularia* has three *ocelli*, simple eyes (specks on the top of the head), whereas *H. equina* has none.

There is also a very characteristic difference in the structure of the claws of the two species. In both species each foot is furnished with two claws, but in *equina* each claw is divided into two portions, in *avicularia* into three.

A reference to the figure of the claw of *H. equina* at p. 53 in the preceding paper, and in the frontispiece, will help to make the above differences clear. It will be seen there that the claw of *equina* is divided into one long curved portion, with another, a lumpy obtuse portion, attached, which is about half the length of the curved and pointed part. In regard to *Ornithomyia*, it is mentioned by Dr. J. R. Schiner in his account of the characteristics of this genus,* that "*the claws have two side claws, and thus are three-toothed.*"

On examining Mr. Wheler's specimen with a quarter-inch object-glass, I found the uppermost longest division of the claw rather more slender and flatter than in *equina*, and very sharply pointed; the next division (corresponding with the thumb-like or lumpy division in *equina*) much longer and somewhat narrower in proportion than that of *equina* (about two-thirds of the length of the pointed portion), and very obtusely ended. The third division was not so well defined, apparently from the balsam or preservative medium having soaked into it and made it partly transparent. But this was dark at the base, and where I was able to get what seemed a correct view, it was merely a small body about the width of the other blunt claw, but only about half its length, and ending in a very blunt point, so as to give it almost an oval shape, also there was a raised vein, or ridge, and one or two lesser elevations running along it longitudinally. From want of sufficient specimens to examine, I was not able to make out the nature of this division or lobe of the claw quite clearly, but it appeared as if, although horny, it was not of such exceedingly hard substance as the other divisions of the claw, and I only submit an imperfect description.

* 'Fauna Austriaca (Diptera),' von J. R. Schiner, ii. Theil, p. 646.

The bearded hair, first, I believe, observed by De Geer, and recorded by him as found on this *O. avicularia*, was very noticeable. Of this he remarked in his paper (referred to below*) on the "*Hippobosque verd*," *Hippobosca* (now *Ornithomyia*) *avicularia*, Linn. :—

"Between the '*pelottes*'" [pads or pulvilli] "there is placed a very remarkable bearded hair, having bristles on each side like a little feather, which is attached beneath the foot. We have already mentioned that the *Hippobosca* have a similar hair appended to their tarsi."—(C. De G.)

This bristly hair will be found figured at p. 53, and also in the Plate at frontispiece, as seen on the feet of the Forest Flies of the New Forest; in the case of Mr. Wheler's Grouse Fly, the hair was more curved in different directions, and the side hairs (as seen) were longer and fewer in number; but, as previously observed, the amount to which the side hairs are observable depends to some degree on the nature of the medium in which they are displayed.

I also noticed, amongst the appendages of the claws of this Grouse Fly, the very peculiar structure, figured in the frontispiece, at the base of the claws, as a flat membrane, with a series of slightly curved tubes, or ridges (much resembling what are sometimes known as "pseudo-tracheæ"), on each side of a central longitudinal vein, or tube. In *H. equina* this membrane is in connection with a bulb-shaped organ covered with what appear to be short hairs, which is also figured in the Plate above referred to, and which I have described at p. 101 of my Nineteenth Annual Report, but which I believe had not previously been observed, nor do I know its uses. In the Grouse Fly, as the specimen had not been specially displayed for figuring, I was unable to get a view of the bulb, and, should it be feasible further on in the year, it would be of interest to obtain specimens which would supply material for a fully detailed representation of the claw of *O. avicularia* with all its appendages.

The colour of the fly is very variable, being noted as sometimes of a horn-yellow, sometimes brown or brownish above, and again, in some cases, the lighter parts are entirely green. The wings are tinged with brown, and longer than the abdomen.† The body and legs are bristly and hairy.

The flies are not uncommon, and are parasitical on birds, but often wander to human beings, and settle in the hairs of the head and beard.

Some of the different kinds of wild birds which are mentioned by

* 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, vol. vi. p. 288.

† For detailed description of neuration of the wings of the genus *Ornithomyia*, see Schiner's work, previously referred to, part ii. p. 646.

Macquart as liable to infestation are hawks, starlings, magpies, partridges, blackbirds, larks, redbreasts, and titmice.

Like the *Hippoboscidæ*, the *Ornithomyiæ* are pupiparous, not oviparous (that is, not propagated by egg-laying), nor do they live on their hosts as larvæ, or maggots, but pass this stage in the abdomen of the female, and are deposited at its completion, just at the commencement of the pupal stage. The pupa of *Ornithomyia* is noted by Léon Dufour * as being black, two or three times smaller than that of *Hippobosca*, smoother, and more shining, and of the same general conformation, but *without* the notch at the posterior extremity. For figure of pupa (or puparium †) of *Hippobosca equina*, life size and magnified, see p. 50, preceding.

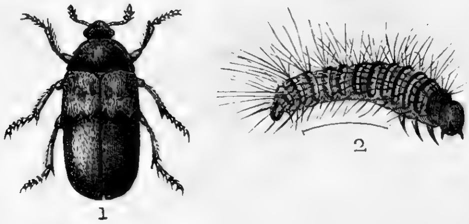
For methods of prevention and remedy, the natural powers of the birds would appear calculated to supply all that is necessary. These Spider Flies have the same power as the Horse Forest Flies of walking with facility and speed backwards or forwards or to either side (*vide* Dufour, previously quoted). But the claws of the insects have not the power of clasping on the quills of the feathers of birds as they have on the individual hairs of horses and cattle, and consequently much irritation must be spared regarding this point. With regard to irritation of the skin from traffic and passage of the Spider Flies, the bird holds the remedy in its own beak and claws; and in Mr. Wheler's notes, at page 57, he mentions the number on each bird as generally being only two or three.

* L. Dufour, "Sur les Pupipares," p. 83.

† The word *pupa* refers to the insect itself in the intermediate condition between that of *larva* and *imago*, or perfect insect; *puparium* is the case or dry skin in which (as in flies, for instance) the change is carried on, but the words are often in popular use not confined to their precise meanings.

LARDER BEETLE.

Larder Beetle; Bacon Beetle. *Dermestes lardarius*, Linn.



Dermestes lardarius.—Beetle and larva, magnified.

The Bacon or Larder Beetle, which takes its popular names, respectively, from one of its special haunts, and also one of the many substances which it chooses for its attack, is one of the infestations regarding which there is a steady moderate amount of inquiry, but yet with little or no addition to the information which we are already possessed of regarding the destructive habits of the pest, or as to means of prevention. The accounts confirm what we already know of the waste and annoyance caused by this beetle and its maggots as a house or store pest, and suggest that it would be of use for more information of its habits to be generally accessible.

The beetle is of the shape figured above from life (magnified), that is, oval, from a quarter to a third of an inch in length, black in colour, excepting a pale yellowish or brownish yellow band across the lower half of the wing-cases, covered with a thick grey down, and usually bearing three black spots (on each of the wing-cases). Beneath them I find a pair of strongly veined wings. The head is bent down; the antennæ (horns) short, with the clubs at their extremities 3-articulate. The under side of the body slightly clothed with ashy-down or scales.

The larva, or maggot, is about half an inch or rather more in length, dark brown (or broadly striped across with dark brown) above, and thickly covered with brown hairs; under surface white.

The infestation has been known in Europe for more than two centuries, and is now cosmopolitan in distribution; it is found both in Asia and America; and in the United States, where it is as great a pest or even greater than with us, it is now considered that it may be possibly native as well as introduced.

The main points of the life-history, taken from German observation,* are that the beetles develop from the chrysalis state in October

* See 'Praktische Insektenkunde,' by Dr. E. L. Taschenberg, pt. ii. p. 24.

or later, but remain (where they are not in warm quarters) for the winter in their places of development ("Weige," or cradles), and appear early in the following year, often in the first days of April.

Propagation begins about May, when the eggs are laid on such substances as serve the beetles for food, as meat of various kinds, hides, furs, &c.

Dr. Lintner* notes that "there are apparently several broods throughout the year," and that "the cast larval skins, which are thrown off from time to time during growth, often disclose the lurking-places of the active larvæ, buried within the substance on which they are preying."

Of the food of this infestation, Dr. Lintner observes that "it is particularly fond of bacon, although it also preys on other dried meats, as hams, &c., also on cheese, peltry, skins, horns and hoofs of dead animals, feathers, insects in museums, and mounted birds and mammals"; . . . but "it does not eat clothing of any kind unless it encloses or is heavily charged with fatty matter. It is the larva that commits by far the greater depredations, the perfect insect being comparatively harmless, except as it continues the species by the deposit of the eggs."—(J. A. L.)

In the paper by Dr. Lintner, noted above, are references to observations, with quotations from various publications on bee-keeping, showing that *D. lardarius* also feeds on wax, and on dead bees and pollen in the comb; and in an observation quoted from Prof. C. V. Riley (Entomologist to the Department of Agriculture, U.S.A.) he remarks that specimens of the larvæ sent to him fed ravenously on wax, and after changing their coats several times became beetles.

The latest information I am acquainted with as to the life-history and habits of this beetle is that given in the publication referred to below, which brings results of research up to 1896.† Here it is noted that "under favourable circumstances the insect is unquestionably a rapid breeder." An instance is given of an observer having placed a female beetle in a glass jar with a piece of meat, and five weeks afterwards "a large and flourishing colony of larvæ, most of them full-grown," were found.

Quotation is made from Dr. G. H. Horn, in the 'Proceedings of the Entomological Society of Philadelphia' (1861, vol. i. p. 28), who states that the insect remains in the pupa condition for a period

* See paper on "*Dermestes lardarius*" in 'Sixth Report of Injurious and other Insects of State of New York,' pp. 119–123, by Dr. J. A. Lintner, Albany, U.S.A. 1890.

† 'The Principal Household Insects of the United States,' by L. O. Howard and C. L. Marlatt. Bulletin No. 4. New Series. United States Department of Agriculture, Washington. 1896.

varying from three or four days to a week, or even more, depending principally on the warmth of the locality.

I extract the following passage *verbatim* from the U.S.A. Bulletin (referred to at page 61), as it contains very useful information, and, joined to the observations previously given, seems to me to furnish all that we need to know for practical purposes as to the life-history and habits of this destructive pest:—

"From this statement" [that of Dr. Horn, quoted above, E. A. O.] "we see that an entire generation may be developed in six weeks. Therefore the increase of the insect may be very rapid, and there may be four or five generations annually. The larva, when feeding upon dried and smoked meat, according to Dr. Horn, is usually seen creeping on the surface of the meat. For food it prefers such as contains fat and connective tissue, seldom attacking the muscular portions. It does not bury itself in its food until about the time of assuming the pupa state.

"In general the beetles make their way into houses in May and June, and at once deposit their eggs on their favourite food if they can obtain access to it. Where this is impossible, they will lay their eggs, as well as other beetles of the same family, near small cracks, so that the young larvæ when hatched can crawl through. Dr. Riley, in his 'Sixth Missouri Report,' states that fresh hams are not so liable to attack by this insect as those which are tainted or injured."—(L. O. H. and C. L. M. in Bulletin referred to.)

One important point which may be gathered from the above observations is that the customary time of appearance of the beetles which start the summer attack is noted as taking May for its centre, being April and May in the German observations; in May and June in those of the United States; and in one of the observations sent to myself last year (1898) from an old manor house in Leicestershire, the date of appearance coincides with what may be called "average date." My correspondent wrote on May 11th, forwarding specimens which had "lately made their appearance."

One point of the structure of the beetle does not seem to me to be sufficiently attended to in considerations of preventive measures, and that is its possession *of strongly-veined wings.* If it is in the habit of using these for flight, its sudden appearance and distribution is not to be wondered at.

Prevention and Remedy.—One method is enclosing substances likely to be attacked in stout muslin or paper sacks or wrappings, taking care that this is done *in good time,* before the beetles have had a chance to deposit their eggs, and also taking care that there are no cracks or tears in the wrappings through which the beetles may make entrance for egg-laying. Where the above is not practicable, frequent examination of the meat stores to ascertain whether maggot attack is noticeable would be very desirable.

It has been suggested that where a store-room is infested the contents should be cleared out, and the room "either be sprayed with benzine or subjected to strong fumes of bisulphide of carbon." I should *not* myself like to advise either of these applications on account of the great danger from their inflammability, especially in the case of bisulphide of carbon, which is liable to ignite at a raised temperature, even without the presence of flame, as of fire, candles, &c.

In many cases a thorough good clearing out of the infested larder, or store, and washing and "swilling" floors and every accessible part (especially all crannies) with hot soft-soap and water, as near scalding heat as can be managed, would do much to clear out the infestation, which appears to me (in private houses) to depend very much on the amount of care given to general order as well as to condition of stores. Before bringing back the removed contents of the larder, or other infested rooms, everything should be examined. Meat should be lifted from anything it is lying on, and piles of plates or basins raised one from the other so as to ensure that there are no beetles hidden away among them.

Where the outside of bacon or other meat is found to be maggot-infested on the surface, this part should be cut away and burnt. It has been suggested that the exposed surface should be washed with a *very* dilute carbolic solution. This, if not objected to as giving a slightly peculiar flavour to the bacon or other meat, would almost certainly do good in a remedial point of view.

Nothing (so far as I see) has been suggested as to a treatment which sometimes does all that could be wished in clearing *broadscale* infestations where steam power is available. By turning on scalding steam from an engine at hand it might be certainly hoped that beetles and maggots alike would be got rid of.

Amongst other methods of lessening attack, whitewashing meat, such as flitches of bacon, has been mentioned; and also trapping the beetles by placing cheese to attract them. This is noted as having proved very successful, the beetles resorting eagerly to the cheese, so that examination, and hand-picking and destroying the creatures two or three times a day, in this case "practically exterminated them."

Where larder or store-room windows are open to the outer air, it might prove serviceable to place screens of fine wire, or netting, or wire gauze to prevent access from the outside at times when the beetles were likely to be, or were known to be, about.

MANGOLDS.

"Ground Beetles."

Pterostichus (=*Steropus*) *madidus*; *P.* (=*Omaseus*) *vulgaris*, Linn.

Pterostichus madidus, magnified, and line showing natural length. Mangold roots injured by the beetles.

The attacks of Ground Beetles were first definitely reported as being noticed as a cause of serious injury to Mangold roots amongst the observations sent in 1885, but since then the infestation has been again noticed, until it is obvious that the attack must be looked on as a trouble to which Mangold roots are certainly liable, although not necessarily to the severe extent which the subsequent appearance of the same kind of beetle in Strawberry beds (first reported in 1894) has proved to Strawberry fruit in various localities.*

The kind of attack is of great interest both practically as well as scientifically from the circumstance of the Ground Beetles (*Geodephaga*) being of a class which, till of late years, was supposed to be almost wholly carnivorous in its diet,—that is, to limit its attacks mainly to worms, maggots, or other small animal material,—and, consequently on the first observations of the beetles as seriously destructive to Mangolds and Strawberry fruit, much attention was given to identification to be absolutely certain of the species present.

The first notes of attack with which I was favoured were sent me on June 29th, 1885, by Mr. T. James Mann, from The Grange, Bishops Stortford, Herts, together with specimens of the beetles taken in the act of feeding on the roots of Mangolds at 3 a.m. that morning. A little later on more beetles were sent which also had been captured early in the morning in the act of preying on the Mangolds, and specimens of the attacked roots were also sent as good examples of the

* Observations of successful methods of prevention and remedy of attacks of Ground Beetles to Strawberry fruit will be found further on, under the heading of "Strawberry."

method in which they were eaten off. Two of these roots (figured at heading, p. 64) show the method in which the substance of the root has been gnawed away into pits and grooves by the mandibles of the beetles. The greatest size of root mentioned as being attacked was about five to six inches in length, and an inch and a quarter to an inch and a half diameter at top.

In this case the beetle proved to be *Pterostichus* (= *Steropus*) *madidus;* for figure, see p. 64. This species is from about half to three-quarters of an inch in length, of a shining black in colour, though the legs or thighs are sometimes of a red tint. The jaws are large and curved; the legs long and strong; and it is *without wings*, a very important point in consideration of prevention. This species may be to some degree distinguished from two other nearly allied species, very similar in appearance, by the hinder corners of the thorax not being acute or bluntly pointed, but rounded off, so as to be narrower than the base of the wing-cases (see figure, p. 64).

The injury caused by the attack was at or about ground-level, or a little above it, to the top of the roots, and was sometimes all round what may be called the shoulders of the root, or sometimes on one side, or in patches. In the case of the specimens figured, it will be observed that the roots have been entirely gnawed through. The beetles did not eat the leaves.

The loss was estimated by Mr. Mann, after examination of the attacked crop, to be one plant in every ten; in one part of the field, one in every five.

From the fact of the beetle being a night feeder, its presence as the cause of mischief is very apt to be overlooked, as very few observers are disposed, even on summer mornings, to be so early on the alert as 3 a.m. so as to secure an observation before the beetles have hidden themselves from the dawning light, in the ground, or under any rough shelter, as dried manure. The field in this case had been manured at the rate of ten loads of farmyard manure, 4 cwts. superphosphate, and 2 cwts. of salt.

The above notes are given once again (in abridged form) as being the first contribution of information sent as to presence of Ground Beetles as a serious infestation to Mangolds, and also as being accompanied with carefully detailed notes of observation of time and method of attack, and with specimens, which enabled trustworthy identification to be made, of the beetles taken in the act of doing the mischief.

Since then, little inquiry has been forwarded as to presence of Ground Beetles, excepting at Strawberry crops, to which, in some localities, they have proved disastrously injurious. Still, enough has been sent to show that the infestation is one which may only too certainly rank amongst our farm attacks; and in the past season I was favoured by the following observations regarding Ground Beetle attack to Mangold, which were sent me from Brunstead Rectory, Stalham, Norfolk, by the Rev. Maurice C. H. Bird, with specimens accompanying. These proved, on examination, to be of two species of Ground Beetles (*Geodephaga*)—some of *Pterostichus* (= *Omaseus*) *vulgaris*, and some of a smaller kind, which did not differ, so far as I could see, from *Calathus cisteloides* of Panzer. This is only from about three to six lines in length (that is, from about a quarter to half an inch). The colour black, with *antennæ* (horns) and legs brownish red. The thorax slightly narrowed before, sinuated behind, and the hinder angles rounded off. *The wings absent or imperfect.*

Pterostichus vulgaris is six and a half to seven and a half lines in length, or possibly more. Wholly black, and rather shining. Thorax rather broader than long, with the hinder corners bluntly pointed. The wing-cases strongly and smoothly striated. *Wings absent.*

The reader is asked to notice that in the case of each of the three above-named species the wings are either wholly absent or imperfect, as this inability to transport themselves by flight about the country is a very important consideration in regard to prevalence of attack, and success in remedial measures. A figure of *P. vulgaris*, magnified, will be found at heading of the paper on Strawberry attack by Ground Beetles.

Regarding the attack to Mangolds of the above-mentioned beetles, the Rev. Maurice Bird wrote me from Brunstead Rectory, Stalham, first on July 5th, as follows:—

"I am now sending you some Ground Beetles and Mangold plants to show cause and effect, as I believe. This forenoon, my friend Ash Rudd, J.P., landowner and farmer near by, called and asked me to go and inspect his Mangolds. I found fields cropped with most choice varieties, and so most valuable for feeding purposes, *i. e.* those containing most sugar, were chief sufferers, cut off just above ground after the plants had been singled out. I searched deeply and carefully all over several fields, and could find no trace of Slug, Snail, or Wireworm, or Rabbit work, but the enclosed beetles were near by nearly every bitten-off plant. I am aware that they and other allied Ground Beetles are generally supposed to be carnivorous, but think that it was fully proved that they last year spoilt the Strawberry crop in this neighbourhood. Would you kindly give me your opinion as to Mangolds and enclosed beetles?"—(M. B.)

The above note is of a good deal of interest, as coming from an observer acquainted with Ground Beetles and their reputed as well as recently observed habits, and shows an attack of considerable extent characterized by the Mangolds being cut off just above ground; and, what is of great importance practically, that on Mr. Bird searching "*deeply* and carefully," he found beetles near to almost every bitten-off plant.

This agrees with a note of observation sent me regarding day shelter of Ground Beetles in the case of Strawberry attack:—"The beetles lie round the plant and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter, the opening being through the litter and just under the bunch of fruit attacked."

Whether this habit can be utilized for remedial measures in the case of Mangolds does not as yet appear. The beetles might presumably be disturbed by hoeing or other agricultural treatment that would go deep enough, and in the case of grubs, or caterpillars, might be hand-picked, or left to be cleared by birds. But the Ground Beetles, with their long and strong legs and power of speedy running, would conceal themselves again in the disturbed soil before there would be a chance of catching any number worth the trouble.

In the case of *Harpalus ruficornis*, a nearly allied and exceedingly injurious kind of Ground Beetle (figured under the heading of attack to Strawberries, further on), I found specimens which I kept under observation were pairing about July 20th. It might certainly be presumed that these would shortly lay eggs, and the larvæ (which are mostly found in the same places as the perfect insects) would soon be found in the ground, and probably those of the other Ground Beetles.

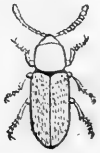
As yet we appear not to have descriptions of their appearance beyond that of the geodephagous larvæ generally. These are described as being usually flat, long, parallel-sided, fleshy, with the head and next segment hard. The three pairs of legs horny, the jaws strong and sickle-shaped, and the caudal extremity furnished above usually with two horny or fleshy appendages, and the lower part lengthened into a kind of "membranous supplemental leg."

The ordinary agricultural treatment of breaking up the ground after the Mangolds have been drawn would probably be about as good a course as could be followed for getting rid of a large proportion of the maggots that were in the land, but we need to know how, in the case of the three wingless kinds of Ground Beetles mentioned above, they become *present* on land not for some years previously to the attack recorded under Mangolds.

The maggots appear to feed on animal substances, grubs, worms, &c., such as were at one time supposed to constitute almost entirely the dietary of the beetles, and as such food is to be found in farm manure, it is certainly open to conjecture that they may be carried in it to the field.

At present, however, much more information on the winter quarters and other points of the life-history is needed before we can tell how to deal with the beetles as a root crop pest. Should the infestation increase so as to be of more frequent occurrence we might expect, from the size of the larvæ, to be able to gain observations, and to trace the development. At present we have not made advance with remedial measures against them as a root crop pest, but in the past season, thanks to Messrs. Laxton, of Bedford, we have been put in possession of most serviceable information of how to deal with them as Strawberry infestation, which, by permission, I give further on under the heading of "Strawberries."

Pigmy Mangold Beetle. *Atomaria linearis*, Stephens.



ATOMARIA LINEARIS (after Taschenberg), magnified; natural length, one twenty-fourth of an inch.

Atomaria linearis, figured above, is an exceedingly small beetle, only about half a line in length, which has long been known on the Continent as very destructive to Beet or Mangold plants in their early condition by attacking the root, and, later on, extending their ravages to the tender leaves; but it was not (so far as I am aware) until the year 1891 that we had definite record of it as a young-Mangold pest in this country. For some years previous to that date inquiries had been sent me, with specimens accompanying, as to the cause of the mischief to young Mangolds by the roots being gnawed, or, in some cases, the little plants being eaten at ground level, to an extent to cause much damage; but there was no clue to the cause of the mischief, and I believe the first *record* of the infestation as a Mangold pest with us was made by Prof. Allen Harker in 1891, when he noticed an *Atomaria* beetle as being seriously injurious to the Mangold crops at the Royal Agricultural College, Cirencester. On February 27th in the following year Prof. Harker wrote to me:—"I think I mentioned to you that I found myriads of a small *Atomaria* at our Mangolds last spring, when we lost about half the crop." At the same time Prof. Harker forwarded me an extract from the publication mentioned below,* in which was given a description of *Atomaria linearis*, and the method of their ravages, with the remark:—"This most accurately

* 'Cours d'Agriculture pratique: les Plantes fourragères,' Betterave, pp. 33, 34, par Gustave Henze. Paris: Hachette. 1861.

describes the appearance of our Mangolds, and I could have collected hundreds of Atomarias at each plant." In that year, 1892, I had specimens and descriptions of attack to Mangolds agreeing well with descriptions of the method of infestation, and it seems to me that it is this, that is, the appearance of the injuries, that we must *practically* rest on for identification, as few but skilled entomologists could give trustworthy identification of beetles of only the twenty-fourth part of an inch in length.

In 1895 I had notes of this well-marked form of injury being observed by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, as doing damage to Mangolds; and since then I had no further reports on the subject until in the past year (1898) notes were sent me of similar Mangold attack being observed near Ashburton, Devon, and also near Weston-super-Mare, which I give further on.

The beetle is described by John Curtis, in his 'Farm Insects,' p. 395, as "elongate-linear, slightly pubescent, varying from black to rust colour; head broad and triangular; eyes slightly prominent; horns chestnut colour, as long as the trunk, slender, eleven-jointed, terminated by a three-jointed club; trunk depressed and margined; wing-cases depressed; wings ample; six short chestnut-coloured legs; the feet five-jointed. Length half to two-thirds of a line."

From comparison of various descriptions of method of attack, it appears that the beetle comes out in May and June (there may also be a second appearance in July and August), and by the middle of June the beetles may be found to have been seriously injuring the coming crop by gnawing little holes in the germinating plants, so that they perish before appearing above ground; or, again, by so gnawing round the top of the plant, or eating the lower part of the leaf-stalks below ground level, that the young plants die off. Other mischief is caused by injury to the tap-root, and if the earth is turned back the wounded parts of the root may be found turned black, and the little beetles found at their destructive work, often in very great numbers.

Later on, *especially in bright sunny weather*, the beetles may be found at work on the young leaves, and sometimes causing much mischief; and on warm evenings the beetles come out of the ground, and rising in the air they pair.

The following observations of attack, which agree well with the details we possess of the method of infestation of this *A. linearis*, were sent me in the past season by Mr. C. J. R. Tipper, from the Grammar School, Ashburton, Devon, with beetles accompanying:—

"I enclose specimens of Mangold plants taken from a field of ours which has entirely gone under. The injury appears principally on the roots, which are gnawed nearly through. We fancied at first it must be Wireworm, but found none of those marauders, but, instead, hundreds of tiny beetles (specimens of which I enclose herewith). Round every root we found the earth swarming, and also found them in the lower parts of the stem, and in the scars on the damaged roots."—(C. J. R. T.)

On June 3rd Mr. James Muir (County Instructor in Agriculture), writing from South Haven, Beach Road, Weston-super-Mare, forwarded me the following observations, with specimens of *A. linearis* (then pairing) sent accompanying, and also a small Mangold plant with the long root injured. Mr. Muir observed that he wrote about an insect attack which had lately been brought under his notice:—

"A farmer in this neighbourhood,—Mr. Hawkings, at Northam Farm, Berrow,—wrote me that his Mangolds were dying off in a patch where they also failed last year. (Having little arable land, he grows Mangolds year after year on the same land.) On visiting the field, I found that a large patch had been entirely destroyed, and that it was steadily spreading. The plants came up quite well, but afterwards appeared to wither and die, and at, or a little below, the surface of the ground looked as if they had been bitten. Enclosed I send you a tube containing an affected plant and several specimens of a small beetle, which I found in considerable numbers in the soil close to every dying plant that I examined."

Mr. Muir expressed his wish for information as to the nature of the attack, and how to stop it then, and to prevent its recurrence, and added further:—

"I should perhaps add that the manure used for the crop was cow-dung applied in the autumn, and salt, superphosphate, and nitrate of soda before drilling. Also that a few Cabbage sown with the Mangolds are unaffected by the attack."—(J. M.)

In both of the above accounts the point of the *great numbers* of these excessively small beetles which were observed round the attacked plants should be noticed, as this is a characteristic of the infestation, even (as Prof. Harker wrote me from the Royal Agricultural College) to being present by "myriads"; and this enormous presence not only accounts for the serious failure of the young crop, but also is apt to set observers astray, for the shape of the insects not being clearly noticeable without a magnifying-glass, the infestation may be simply considered to be a visitation of ants.

We have no notes of observation of where the eggs are laid, or on what the maggots feed. Conjecturally, they feed below ground, for, minute as they must be, still, such a quantity of maggots as there must be to turn presently to such vast numbers of beetles could not fail to cause observable mischief to the young leafage, although they themselves may be hardly observable.

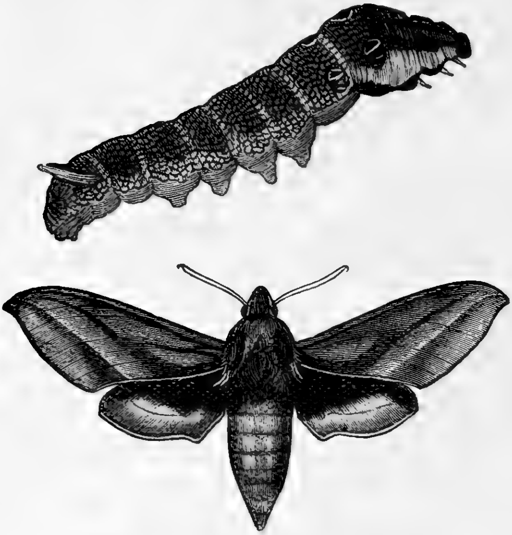
Prevention and Remedies.—In an attack which is so very seldom noticed as this of the "Pigmy" Beetles, it is very unlikely that the cost of preventive measures would be gone to; but the circumstance of *Atomaria* beetles having been recorded as occurring in "vegetable refuse," and also "harbouring in dry dung," may give a clue to localities of hybernation of the autumn or late summer brood, from which they *may* come out in the following spring, in the same manner as "Turnip Flea" Beetles (*Phyllotreta*), to attack the young crop. This, however, like various other points of the life-history of the "Pigmy" Mangold Beetles, we need more information about.

Thick seeding (where attack is considered likely to occur) is a good practice, for thus some part of the plants may survive and give a crop in the case of only moderate infestation.

Thorough cultivation and liberal manuring such as will push on the plants and support them if attack occurs is treatment that will answer in any circumstances; but at present we need more detail of life-history of the beetles to enable us to cope with the attack. Also, up to present date, the attack has so rarely been observed in this country that it does not appear of much practical importance beyond pointing out to us to be ready to meet it, if it should occur to a greater extent.

MURRAIN WORM.

"Murrain Worm," caterpillar of **Elephant Hawk Moth.**
Chærocampa elpenor, Westwood.



Chærocampa elpenor and caterpillar.

During the past autumn I received the following note from Mr. Thomas Wade, of Newcastle-West, Co. Limerick, Ireland:—

"Recently a rather curious case came under my notice here: I was call to see a cow which was suffering. She was standing with her tongue protruding; there was perhaps a little swelling at the back of the tongue. She was breathing sharply and laboured, emitting a groan at each expiration. She was feverish, with a weak pulse. We gave her a dose of linseed oil, and a few drops of tincture of aconite. She gradually recovered, although it took her four or five days. The farmers, not only here, but all over Munster, seem convinced that this illness is caused by 'a worm,' and from their description it is evidently a lizard, or something akin to it, which is taken up by the animal when eating grass, and thus gets stung. I know of nothing which might do it. . . . I should be very glad if you could give us any advice on the matter. I have not a specimen by me of the 'worm,' or I should have sent it you."—(T. W.)

Here, it will be seen, we have a *definite* account of sickness of the animal (giving way to the application of remedies), and also the popular view (to which Mr. Wade does not in the least commit himself as to it being correct) of the sickness being caused by some small creeping thing taken up by cattle in the grass on which they are feeding.

Now (though not myself qualified to give an opinion on veterinary matters), it chanced that in the year 1887 I received two applications, in each case with specimens accompanying, regarding a very large and repulsive-looking caterpillar, called the Murrain Worm, "sometimes said by popular voice to give the disease called 'murrain' when licked or swallowed by a cow." This caterpillar, on investigation, proved to be the larva of the Elephant Hawk Moth (*Chærocampa elpenor*), and it seems almost certain that the above observations must refer to *two parts of the same attack.* In one case we have the large luridly-coloured grub called the Murrain Worm, and credited with causing murrain in cattle; in the other, we have the precise report of cattle-sickness credited to some small creeping thing swallowed as the origin of the illness.

It may certainly be supposed that the caterpillar is entirely innocent of causing the sickness; but, looking at the circumstance of this larva especially frequenting ditches and feeding on plants that grow by the water, it appears to me very likely that sickness may be caused by poisonous water plants, and the caterpillar, being seen accompanying, be erroneously considered to be the cause of the mischief, and it may therefore be of interest to give some information as to the habits of the caterpillar.

Such details as I have are as follows. In the summer of 1887 Miss Fleming, writing from Derry Lea, Monasterevan, Co. Kildare, Ireland, remarked :—

"There is a very large caterpillar sometimes found here (I have seen it four inches long) which is said by popular voice to give the disease called murrain when licked or swallowed by a cow. The people call this creeping thing a 'Murrain Worm.' . . . The last I saw was on the approach, travelling as if it was running for its life."

On August 7th (in the same year) Miss Fleming forwarded me a specimen of this so-called "Murrain Worm," which turned out to be the caterpillar of the "Elephant Hawk Moth."

On August 20th another specimen of the same kind of caterpillar was sent me by Mr. N. Richardson, from the Estate Office, Castle Comer, Co. Kilkenny, Ireland. This was beginning to spin itself up in a light web, and the figure of the caterpillar at p. 72 gives a very good idea of its strange shape. The larva is three inches, possibly more, in length, and *when extended* the front segments taper rapidly to the head, but it has a power of retracting the head and the first and second segments immediately behind it into the third, which is then puffed out, and the strange shape, added to the frequently peculiar colouring, thus gives a very repulsive (to some people, alarming), look to the creature.

The colouring is sometimes brownish buff at the folds, with a net-work of blackish freckles, excepting on the three segments behind the head; these have a band along the side of dusky buff, enclosed in a blackish border, which on the furthest of these segments from the head swells out into a darker blotch. The head and a small curved roughish horn only about a line long, placed above near the caudal extremity, are black. The under side of the grub is buffish, freckled with a smaller pattern than that on the back. The other variety has the ground colour dull green.

The three excellent coloured figures at plate xxv. of the work mentioned below * give life-like representation of the caterpillar, with a figure of the pupa accompanying; and in the paper on this *C. elpenor*, at pp. 113–115, in the volume referred to, will be found detailed information regarding the markings of the larva, and various useful points of its life-history, especially as to the nature of its food-plants. Mr. Buckler's notes of these, when the caterpillars are feeding in natural circumstances, show these to be plants that grow by the water, of which the "Great Willow Herb" (*Epilobium hirsutum*) and the "Marsh Bedstraw" (*Galium mollugo*) are particularly specified. Also a quotation is given by Mr. Buckler from Albin, showing the predilection at least of the larva for watery localities, namely, that "there is something in this caterpillar very remarkable, *viz.* his dexterity in swimming, for, commonly feeding in or near the water, if at any time he happens to fall in, he turns himself on his back, and swims with his head and tail turned together till he gets hold on some part of the plant, by which he helps himself up again." This may or may not be correct, but the *fact* of the caterpillar feeding on plants growing in or near water is very important practically.

When full-grown, the caterpillar spins a web (such as was being begun by one specimen sent me) of an open but strong net-work "on the surface of the soil, sticking in dry leaves and bits of earth, &c.," in which it changes to the chrysalis; this is somewhat over an inch and three-fifths in length, the ground colour light buff, variously marked with blackish or smoky colour, and with the abdomen ending in a triangular curved spike.

The moth, to which this develops (figured at p. 72), is a pretty creature. The thorax and abdomen olive coloured—the first with four pink lines, the latter with three broader stripes running lengthwise; the fore wings olive, with transverse bands of pink; the hind wings of a deeper purplish pink, with base and fore edge of a blackish tint.

* 'The Larvæ of British Butterflies and Moths,' by the late William Buckler. Vol. ii. London: Printed for the Ray Society. MDCCCLXXXVII.

The moth is rather common in some localities, especially in the south of England.

Methods of prevention and remedy are not needed with regard to these caterpillars; but—looking at the widespread belief of illness to cattle being caused by their eating some small creature or caterpillar, which, when sent for identification, proved to be the larva of the Elephant Hawk Moth, which most especially feeds on plants growing by ditches or in wet places—it would appear to be worth while for some qualified observer, when opportunity should occur, to find whether the illness—the so-called "murrain"—may not be attributable to *some poisonous water-plant*, which, if known of, could be removed.

In the paper entitled "Two Poisonous Plants," by the Consulting Botanist of the Royal Agricultural Society (see Journal of Royal Agricultural Society of England, Third Series, vol. ix. pt. iii. p. 561), will be found an account of deaths of cattle and sheep, accompanied by symptoms agreeing with what had been previously observed in cases of eating the tall-growing umbelliferous plant popularly known as Water Dropwort, or Water Hemlock, scientifically as *Œnanthe crocata*, Linn. Plants of this were found in the ditches to which cattle had access. What plant or other evil may be the cause of the so-called "murrain," remains to be seen; but this widespread trouble, which more or less appears now to have given disturbance for at least twelve years, would certainly be worth some skilled investigation as to means of prevention and remedy.

NUT.

Hazel and Filbert Bud Mite. *Phytoptus avellanæ*, n. sp., Nalepa; *Phytoptus vermiformis*, Vallot, Targioni-Tozzetti, Nalepa.*

The swelled and deformed bud growths on shoots of Filbert and Hazel Nuts, caused by *Phytoptus* presence, are not often the subject of inquiry; but from their great similarity in shape to those of the Black Currant, they are so apt to be attributed to mischief caused by the Black Currant Mite (*Phytoptus ribis*), that some reference to them seems needed.

The infestation appears to be becoming rather more prevalent during the last few years, but, from the less favourable circumstances

* For figure giving a very correct *general* representation of the form of the female Nut Bud Gall Mite, see that of Currant Bud Mite, p. 34.

for propagation afforded by growth of Nut bushes to that of Black Currants, it may well be hoped that the infestation will not prove such a disastrous scourge.

One of the worst cases of infestation of Filberts which I have myself seen was where the bushes appeared to have been neglected for several years, and were overhung by trees; and also on a hedge where the Nut bushes had been trimmed back so as to have many shoots; and where they were in a damp locality between a willow ground and a shady lane, I have seen the galls in profusion.

The attack is very similar to that on the Black Currants, for figure of which see p. 34. The infested buds similarly develop into swelled knob-like form, which may be described as a spherical growth, consisting of an abnormal number of bud-scales and abortive leaves, which are thickened in structure, and more or less sprinkled with hairs or other excrescences. The progress of the plant injury is also similar to that of the Black Currant attack. The deformity of the infested bud is advanced so far as to be observable early in the spring, and later on the galled buds, having attained their full growth, dry up and perish, and with the growth of the Nut shoots in July and August, a new growth of galled buds commences.

The life-history of the Mite, or *Acarus*, which gives rise to the bud-galls, is similar to that of the Black Currant Gall Mite. It belongs to the *Phytoptidæ*, which differ from the other divisions of the great order of *Acarina*, of which they are one of the families, in being more or less elongate and cylindrical in shape, and also in possessing throughout their lives only four legs. Propagation is by eggs. After passing under various appellations, including for a while (when considered to be a distinct genus) that of *Calycophthora avellanæ* of Amerling, the species is now placed amongst others of the genus *Phytoptus* as *Phytoptus avellanæ* of Nalepa, and it may also be referred to as *Phytoptus vermiformis* of Vallot, Targioni-Tozzetti, and Nalepa. The deformed growth of the Nut buds was known of by Vallot as long ago as the year 1834.

The Mites are too small to be distinguished by the naked eye, and, both in shape and size, resemble those of the Black Currant, *Phytoptus ribis* (of which a much magnified figure is given at p. 34), so greatly, that for all practical purposes this figure is sufficiently descriptive.

The shape is cylindrical, occasionally spindle-shaped. The females attain a length of 0·21 millimètre, the males of 0·18 millimètre—that is, of twenty-one hundredth, and eighteen hundredth of a millimètre respectively; and a millimètre being the twenty-fifth part of an inch, it is obvious that about a fifth part of that measure cannot be clearly distinguished by the naked eye. The fore part of the body is somewhat triangular, rounded in front, and beneath the body, quite at this extremity, are placed the two pairs of legs.

Those who desire the fullest and best possible account of the characteristics of this species will find it, accompanied by greatly magnified figures of the male and female Mite, and also a sketch of Mite-deformed buds, in the work by the great writer on this division of *Acarina* referred to below.*

The methods of prevention and remedy are on the same principle as those for Black Currant Mite in respect of getting rid of the infested Mite Galls; but from the different method of growth of the Nut bushes to that of the Black Currant, there must necessarily be some difference in the details, as of pruning, &c., by which they are carried out. All information available up to date regarding *Phytoptus ribis*, and possible methods of prevention and remedy, will be found in the Appendix to my Twenty-first Annual 'Report on Injurious Insects,' pp. 141–158.

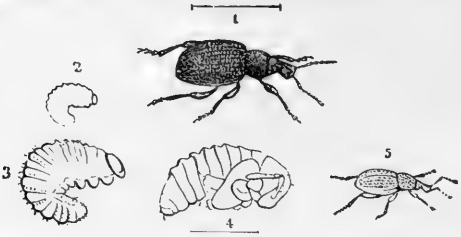
ONION.

Notes of considerable interest regarding maggots of the small beetle *Anobium paniceum*, infesting Onion seed exported from England to South Africa, will be found under the heading of "Seeds, Stores, and Wood," some of the species of *Anobium* being very general feeders.

* 'Beiträge der Systematik der Phytopten,' von Dr. Alfred Nalepa, pp. 15–18, pl. ii. figs. 1, 2, 3, of male and female *Phytoptus;* and pl. iii. fig. 3, of deformed buds. Wien, 1889. Information will also be found regarding the infestation under the synonym of *Phytoptus coryligallarum*, Targ., in the 'Prospetto dell' Acarofauna Italiana' of Prof. Giovanni Canestrini, parte v. p. 611, tav. 52, fig. 9. Padova, 1892.

ORCHARD AND HOPS.

Clay-coloured Weevil. *Otiorhynchus picipes*, Fab.
Red-legged Weevil. *O. tenebricosus*, Herbst.



OTIORHYNCHUS PICIPES and O. SULCATUS.—1–4, *O. sulcatus*, maggot and pupa, natural size and magnified, or with lines showing natural length; 5, *O. picipes.*

The great injuries and losses caused by *Otiorhynchus* weevils have been referred to so often under the headings of the different kinds of fruit crops to which they are injurious, that it would hardly seem worth while to notice them again, excepting that, besides inquiry being sent as to the life-history of the Clay-coloured Weevil (*O. picipes*) and means of stopping its depredations on Apple, Plum, and Gooseberry, notes were sent from two inquirers regarding this kind as doing serious mischief in Hop grounds.

This beetle, figured above, life size, at "5," is about a third of an inch in length, wingless, yellowish or reddish brown or testaceous in colour, and mottled with patches of brown or grey scale, so that when only slightly magnified it has almost the appearance of clay adhering to it, whence its common name of the "Clay-coloured Weevil."

O. picipes.—Larva, nat. size; pupa, nat. size and magnified.

The maggots are legless, whitish, fleshy, and somewhat hairy (see figure, after Curtis, accompanying), with yellow or ochrey heads and jaws. They may be found in the ground by the plants on which the beetle feeds from about August till spring, when, about April, they turn to chrysalids (see figure, magnified). The depth at which they are to be found appears possibly to vary with the nature of the ground, but to be generally not far from the surface; and the chrysalids are very like the beetles in shape, but whitish or yellowish in colour, with the forming limbs folded beneath them (as figured), and without power of movement until the complete development to beetle state takes place, which soon occurs. The eggs are laid a little below the surface of the ground.

The first note regarding the presence of this species on Hop was sent me on June 11th from Badshot Farm, Farnham, Surrey, by Mr. H. Gardner, with a large number of specimens of *Otiorhynchus picipes* accompanying, and a request that I would suggest some method of destroying the weevil "in the ground sent herewith."

Mr. Gardner mentioned that the first traces which he had seen of them was in the previous year (1897) in a piece of young Hops, but this year (1898) they seemed to be much stronger, and were spreading to a great extent in the Hop-ground, and there was reason to fear that if something was not done the whole garden would be destroyed.

In Mr. Gardner's reply to such information as I was able to give, he favoured me, on June 28th, with the following note, which I take leave to insert in the hope that it may be of some service:—

"The only practical way I found to deal with the weevils was as follows:—Select what bines had not been injured and lay them out on the ground, as they were much safer there than up the poles. Then stripped all the leaves off, and searched closely around the crown of the hill, cracks in the poles, and under any bark on the poles, sometimes finding as many as twenty-five on a hill, and at the same time stopped the cracks in the ground and around the poles; then put a few leaves on crown of hill with a stone on top of them; put the bines up the poles, and searched the hills daily, till at last we could scarcely find one in an hour. It has been a most expensive job, but, as there are seventeen acres of Hops in the field, it was a serious matter."—(H. G.)

The above, it will be seen, is a plain commonsense application of the principle of trapping these *night-feeding* beetles, which hide anywhere convenient to themselves during the day. Several other methods of arranging shelters under which they may creep and thus be readily collected together for a morning clearance are given further on; but there appears no reason why the great Hop leaves, which are at hand, without outlay in collecting or fetching, should not answer excellently, when weighted down as above mentioned.

On May 14th another communication was sent, with specimens of *Otiorhynchus picipes* and of injured bine accompanying, from a firm in the Borough, with the observation:—

"We send you by post a sample of a new enemy to the Hop farmers. Can you kindly inform us how to get rid of the pest? They eat the bine (as per enclosed sample), and you will see they are most destructive just at the present period of the year."

In the case of many of the fruit trees or lower growing crops which are attacked by these weevils, the surest way of getting rid of them is based on the circumstance of their falling down when they are out at feed *at night* if a light is suddenly flashed on them, more particularly if the plant (as in Raspberry growing), or the infested bough, is sharply jarred at the same time. If a tarred board or tray is held below to catch the falling beetles, two men may thus clear the pests by thousands, one holding the tarred board, and the other flashing the light and jarring when the board is in readiness below to receive them. Whether this plan (or a modification of it of holding an insect sweeping-net below *part* of the infested plant, and thus collecting large numbers of the weevils by successive applications) would answer with Hops does not seem at all sure, but there are various other forms of Mr. Gardner's plan of trapping which might be worth trying as being effective with other crops without so much trouble in preparation.

One plan consists in smoothing the ground round the infested plants, and then laying some large clods of earth about; under these the weevils are found in large quantities on the following day, and can thus be collected and destroyed. Pieces of board, or tiles, will answer as well, or probably any waste material, such as useless pieces of sacking, so long as there was no smell about it that might be repulsive to the beetles, and which gave a dark place of shelter. In the course of the past season, amongst observations sent of successful treatment in getting rid of this kind of weevil from young orchard trees, the plan was mentioned of putting down small pieces of "bagging" every few yards, and examining them every morning.

The great difficulty in treatment in the case of Hop-grounds appears to be how to smooth the ground and fill up the cracks in or by the Hop-hills, so that there should not be clods for the beetles to shelter under, or crannies for them to go down into, and so evade the trap-shelters. In Mr. Gardner's plan (see p. 79), it will be seen he attended very carefully to this point.

In regard to getting rid of the maggots, it has been found that a strong solution of ammoniacal liquor, and common agricultural salt has been of service in preventing increase of the infestation; also kainite, which sometimes answers excellently in destroying small larvæ lying near the surface of the ground (for reference, see Index), might be of service. But not having myself personal knowledge of Hop cultivation, I only make the suggestion as to possible use of dressings under submission, lest they might injure the Hop roots.

The maggots lie near the surface of the ground by the food-plants of the beetles during the winter, and are large enough to be observable if carefully looked for by someone *interested* in the matter, and if the surface of the hills could be safely disturbed during the winter, so that the infested earth could be thrown aside and exposed to frost and wet, probably a large proportion of the maggots would be got rid of.

The attacks of this species to leafage and of the maggots to roots of the plants on which the beetles feed (and especially their injuries to Raspberry plants), with preventive measures, have been entered on before, as also those of the somewhat larger kind, *Otiorhynchus sulcatus*, figured in its three stages, magnified, at p. 78. This is distinguishable from *O. picipes* by being between a third and half an inch in length, and the general colour being of a dull black; the wing-cases rough, with several raised lines, and spotted with pale hairy tufts. The body between the head and abdomen is granulated, and, *like other Otiorhynchi*, the head is furnished with a short proboscis, and the *wings are wanting.*

This kind is known as the Black Vine Weevil from its colour and from its especial infestation of Vines, and is very troublesome also to growers of Maidenhair Ferns; but, though very injurious, even to the extent of sometimes attacking Turnip crops, it hardly reaches the previously named kind, *O. picipes*, in its vast powers of destruction. The method of life and means of prevention and remedy of both kinds are similar, and so also are those of the kind mentioned below, the "Red-legged Weevil," scientifically *O. tenebricosus*. This species is distinguishable from those above mentioned (when fully developed) by having the wing-cases dotted over with spots of delicate yellow down, but when these are rubbed off the beetle is of a shining black. Sometimes, whilst still immature, it is of a reddish pitchy colour. The wing-cases are united to each other, and the legs are generally of a bright chestnut colour.

This kind was said by John Curtis to be very hurtful to orchard and bush fruits. The beetles are stated to feed on the leaves and young shoots of Plums, Apricots, &c., and the maggots have been found to do much mischief at the roots of bush and ground fruits, as Raspberries, Strawberries, &c. But I have only twice had notes of it as destructive: once in 1883, when I had specimens of it sent me by Prof. Allen Harker as doing mischief to leaves of Strawberries at the Royal Agricultural College, Cirencester (see my 'Handbook,' p. 214); and in the past season as destructive to Pear leafage.

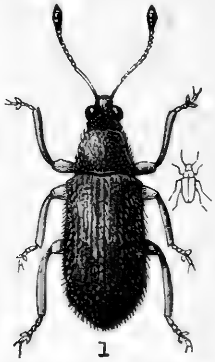
On May 5th, Mr. T. Woods, writing to me from Gillingham, Dorset, with specimens accompanying, remarked:—"This is the third year in succession that the enclosed insect has attacked a young Pear tree growing against the brick gable of a house; it feeds on the leaves."

The general means of prevention and remedy for infestation of this species are similar to those for *O. picipes;* but where (as in the above instance) the attacked tree grows against a wall, care should be taken that the "pointing" of the wall, whether it is of brick or stone, is in good order. Crevices where mortar has fallen out of old garden walls often swarm with *Otiorhynchus* beetles; and with regard to the Pear tree above noticed, as it is mentioned that is a "brick *gable*" against which it grows, very probably there may be pointing or plastering needed beneath the tiles, or between the tiles and the top of the wall, to prevent the weevils having the convenience of a shelter for the daylight hours at hand.

Where attack on wall trees has to be guarded against, the state of the ground at the foot of the wall requires examination, both as to it being a possible day shelter for the beetles during the time of their attack, and likewise a nursery-ground for the maggots during the winter.*

Oblong Leaf Weevil; Downy Brown Leaf Weevil.

Phyllobius oblongus, Linn.; *P.* (*Nemoicus*) *oblongus*, Stephens.



Phyllobius oblongus, magnified and natural size.

The Brown Leaf Weevil, figured above, is only about the sixth of an inch or a little more in length, and somewhat elongate or parallel-sided in shape. The head and thorax are usually black; the wing-cases variable in colour, pale dull red or brown, with the margins often black, or sometimes they may be entirely pale,—my own specimens, from Kent, have been with reddish wing-cases and black borders, also I have them with reddish brown, and yellower brown elytra, without borders; the head, thorax, and wing-cases are covered more or less with a rather long *grey pubescence*. The antennæ

* The attack of *O. picipes* is entered on at length in my 'Handbook of Insects Injurious to Orchard and Bush Fruits,' pp. 210–216, relatively to its harmfulness as a fruit pest; but it is referred to again above consequently on its being noted as a troublesome Hop pest.

(horns) are twelve-jointed, and elbowed; the club elongate ovate; the proboscis short; eyes rather prominent; legs yellowish or brown. This kind differs from the *Otiorhynchus* beetles mentioned in the preceding paper in *being winged.*

From other species of *Phyllobius* beetles, which are for the most part beset with *green scales*, it is easily distinguishable by the *grey down* on its wing-cases.

Like others of the genus which feed on the leaves of trees and bushes, and sometimes do great mischief to orchard leafage, these have been especially reported as doing harm to Apple and Pear in the more southerly part of England; and in the past season Mr. James Thorpe, of Coddington Hall, Newark-on-Trent, was good enough, on May 30th, to forward me the following note from his gardener at Ardbrecknish, eleven miles from Inverary, Argyllshire, which adds a very northern locality to those troubled by the infestation of this species:—

"*Ardbrecknish, May 28th.* — The beetles still keep coming in swarms, although I have killed thousands. I have given them a double strength of 'Gishurst,' four ounces to the gallon; this did for a good many: they don't mind soot or lime. Last night I boiled a lot of water, and after syringing they came on the ground; having the water boiling, I put it on them with a fine rose. This cooked them, so I shall do this every night. I hope we shall be able to keep them from the other trees; they have not got beyond the door yet. They are very hard to kill."—(H. Toogood.)

In Mr. Thorpe's letters from Coddington Hall he mentioned that the attack did not seem to be known in this part of the country; but he remembered that one of the Apple trees in Scotland was stripped of its leafage in 1897, and that doubtless the beetles had bred again in increased numbers. The attack reported was on Apple trees.

The method, as described, of destroying the vast number of beetles syringed down seemed to be effectual and practicable without any great expense; my only doubt about it was how far the scalding water might affect the roots of the Apple trees which lay near the surface. But as, after the application by a rose, and also after sinking some little way through the ground, the water would not be in absolutely boiling state when it reached the rootlets, it might fairly be hoped it would not hurt them; and there is certainly very great horticultural benefit in an application which can be used on ground (not cropped) beneath the trees as a broadscale treatment sure to kill the pests before they can fly away.

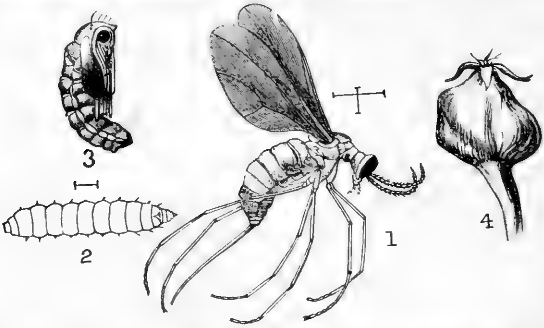
Mr. Thorpe mentioned also that his gardener at Coddington Hall considered an application of paraffin, one wine-glass to two gallons of water, likely to be of service. This he was in the habit of using to prevent attack.

In grass orchards the only way of lessening infestation when present appears to be beating down the beetles on tarred cloths placed below; this answers to some extent in lessening the vast numbers of the nearly-allied bright little golden yellow, or bluish, or green beetles, *Phyllobius maculicornis*, which sometimes infest the leafage of orchard (as well as other) trees. But this shaking down should be done in the morning or evening, or when the weather is dull and still, or else, if the sunshine is bright with a warm temperature, the beetles may very possibly take wing, on shaking being applied, instead of falling, as was intended, on the tarred cloth below.

In regard to the life-history of *P. oblongus*, it is considered that the female lays her eggs in the earth during June, and that the maggots hatched from these feed on the roots of different kinds of plants, and after passing the winter in the ground come out in beetle state in the following spring, but as yet no observations of this part of the life-history of the infestation, as noticed in this country, have been contributed.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra ?*, Meigen and Schmidberger; *C. pyricola ?*, Nordlinger.



Diplosis pyrivora.—Female, magnified; lines showing natural size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

During the past season the attack of the Pear Gnat Midge has been more prevalent and seriously injurious to the young fruit than in any year since 1883, when its presence was first entomologically recorded, though not to any great extent, in this country.

The dates of inquiry ranged from May 13th to June 16th, and the localities written from ranged over a considerable area of the more southerly part of England. These were from near Truro, in Cornwall; Calne, Wilts; Glewstone, near Ross, Herefordshire; Evesham, Worcestershire; from near Leicester; from Cambridgeshire near Newmarket; from Polegate, Sussex; and a note was also placed in my hands by an entomological observer mentioning that "the Pear Midge seems very bad this year, especially in Herefordshire."

Preceding the inquiries sent whilst attack was in progress (with specimens accompanying), I was favoured early in the year by Messrs. R. and B. Bomford, of Pitchill, near Evesham, in the course of communication as to preventive measures in the coming season, with the following report of the attack as they had observed it, which gives such a plain and serviceable account of the general features of the infestation that I copy it *in extenso*. On February 7th Messrs. Bomford wrote as follows:—

"Your description of the maggots is exactly as we have noticed, except that we have not seen them jump about. The attack commences whilst the blossom is still out; the Pears swell up to the size of a sparrow's egg, and if you cut them open just below the eye or blossom, you find about a dozen of these small maggots. In about a week or fortnight the Pear becomes black where the maggots have eaten the inside away. The maggots then disappear, the Pear sometimes falling to the ground; much the greater part fall, but some of them stay on the tree, and come to deformed fruit, quite useless. We do not find any difference in the attack on pasture or cultivated land. We have purposely had sheep under the trees when the Pears fall, thinking they would eat up the Pears, and so destroy the maggots; but we have not found this successful, as some of the maggots evidently fall direct from the trees."—(R. and B. B.)

On May 13th (the earliest date of inquiry as to attack then in active stage sent me) I received the following inquiry from Mr. H. H. Williams, of Pencalenick, Truro, Cornwall:—

"Could you kindly tell me if it is possible to prevent the attacks of the insect which has got into the young Pears I enclose? Last year I picked and burnt all diseased fruits, and this year it does not seem quite as bad. I noticed that one lot of trees which was heavily limed on surface (quick-lime) last autumn have not suffered nearly as much as another lot which were not dressed with lime. Is there any connection in this between cause and effect? Trees on walls seem practically to escape altogether, while by far the worst affected are some grown under a wire fruit cage, Raspberries, Currants, &c., being grown between the rows. Can this be due to the absence of birds? I enclose half a dozen samples of the diseased fruit."—(H. H. W.)

The samples sent showed *Diplosis pyrivora* attack still in early stage. The grubs in some cases were still very young, and the inside of the little Pears injured by being gnawed into little hollows, or cells, and galleries, but the inside not as yet gnawed out into a blackened cavity.

On May 16th, specimens showing attack of this Pear Midge—that is, of *Diplosis pyrivora*—were sent me by Mr. H. F. Getting, from The Gardens, Glewstone, near Ross-on-Wye, Herefordshire, requesting information as to the cause of the small brown or dark velvety-looking spots on the small Pears enclosed.

On May 30th, Mr. Benjamin Bomford again communicated with me, from Evesham, as follows:—

"I have delayed writing to you respecting the Pears, hoping to have a better report to send from the late blossoms, but I am sorry to say we have a complete failure again this year. I posted you some specimens, from which you will see how bad the attack is."—(B. B.)

These specimens, which I received a day or two previously, consisted of five bunches of little Pears, from three to five in a bunch, the largest of the Pears being about five-eighths of an inch across, and three-quarters long.

Many, if not all, of these were distorted in growth,—some lumpy, some contracted on one side and swelled out on the other; and of those that I cut open, fifteen or more showed infestation within. The maggots were of various sizes, from about two-thirds to apparently full grown, and were lying in the gnawed and blackened centre of the Pear. The part between this and the calyx end of the little Pear was also more or less infested, but not the part towards the stem end.

It was difficult to count the number of maggots that might be in one Pear with certainty, as they were much injured in cutting the little fruit open; but I found up to about a dozen in one *half*-Pear. The maggots were in active condition, and dispersed themselves on the paper on which some of the Pears were laid, as if endeavouring to bury themselves.

Most of the Pears were spotted with black, or some had much of the skin discoloured and injured in texture, as if it was drying up preliminarily to the cracking of the fruit, which often takes place consequently on this maggot infestation. In two or three instances the small cracks were already beginning to open.

On June 6th I was favoured by a communication from Mr. Geo. Brown, of The Gardens, Bowood Park, Calne, Wilts, relatively to the nature and means of prevention of an attack to young Pears, of which samples were sent accompanying, and by which very many of the Pears were said to be infested. This attack was also of the Pear Gnat Midge, *Diplosis pyrivora*.

Of above thirty or more Pears sent me (all of which I opened), I found all excepting one were infested. In many cases the attack had been completed, and the maggots gone. In most cases a great part of the inside of the Pear was hollowed out, or decayed, consequently on the attack. The decayed part sometimes reaching across the Pear, and often making a damp, quite soft, decayed condition on part of the side of the Pear through which it was presumable the maggots had made their escape. Some, I found from examination, might very probably have escaped by the communication of the infested decaying and gnawed portion of the inside of the Pear with the opening at the calyx end of the Pear. The maggots appeared to be mostly fully grown, and I counted their numbers up to about six and twenty in two of the Pears which I examined. They were very active, and their skipping powers were very noticeable as they dispersed on the dark red and black tablecloth of my study table.—(E. A. O.; June 7th.)

The following notes, showing presence of severe attack of the Pear Midge maggot on trees where there had been some small amount of infestation in the previous year, were sent me on June 9th by Mr. F. W. Thomas, from Wannock Gardens, Polegate, Sussex, with specimens accompanying:—

"I am sending you some Pears which are attacked by a maggot which I do not know. Last year a few of the Pears on the tree affected turned black, and fell off. . . . On examination to-day I find that the whole of the crop, and also of other Pear trees close by, are attacked by these maggots; not one fruit is good. . . . The Pear maggots, when placed on the table, have the power to jump."—(F. W. T.)

The specimens, about twenty in number, showed attack of *D. pyrivora* similar to other little Pears sent. Some of the Pears were advanced to about an inch in length, and the maggots were leaving, or had left, some of them.

On June 13th Mr. Thomas further wrote:—

"I have done as you suggest, and have gathered all the fruit I can find affected; most of my trees are young, and so I have no difficulty in gathering the fruit; but I am sorry to say I find other trees attacked (although not so badly) in different parts of my garden. I am inclined to think that the maggots sometimes leave the Pears before they drop, as I find a good many still on the trees, but the maggots are gone."—(F. W. T.)

On June 9th a small consignment of Pears was forwarded to me by Mr. W. H. Hall, from Six Mile Bottom, Cambridgeshire, with a request for information as to the nature of the attack.

In this case the samples were in various stages of infestation of *D. pyrivora*, from the early condition of being simply chambered about the centre by the maggots up to the completed destruction in which they had almost entirely left the Pears. The Pears were about three-quarters of an inch long; in some instances the outsides were in large part blackened, in some the patches were grey, and the skin of them roughened, but not yet turned black.

On June 15th, in a note on some other natural history matters from Mr. Fred. V. Theobald, F.E.S., he incidentally mentioned that the Pear Midge infestation appeared to be very bad, especially in Herefordshire; and also that he had found that they laid their eggs in the open Pear blossoms, as well as in the unopened blossom-bud, which is the usual method as hitherto recorded.

The latest date of observation of attack which was sent me was June 16th, when some samples of little Pears affected by the Pear Gnat Midge were forwarded me by Mr. J. Lansdell, from The Gardens, Barkby Hall, near Leicester, with the following remarks:—"I enclose some Pears, which, as you will see, have several little grubs inside them. Our Pear crop is suffering severely from this pest." Inquiries as to the nature and treatment desirable to prevent recurrence of the pest showed that it was a newly observed trouble.

Summary of the above.—Taking the information contributed above *in details* of various parts of the attack as given in the accounts of the observers, or shown by their specimens *as a whole*, it will be found to give a correct and clear description of method of damage.

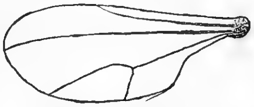
We have observation of the injury commencing on the unopened bud or blossom, and the young Pear, consequently on the presence of the maggots, which may be found up to as many as over two dozen in one fruit, becoming checked and more or less deformed in growth, which may reach (before it is totally ruined) three-quarters of an inch, or perhaps more than an inch, in length.

The presence of the mischief that is going on inside is shown outside by black or grey patches of greater or less extent, and sometimes by the discoloured skin being injured in texture, as if drying up preliminarily to the opening of deep cracks, which are not uncommon in the maggot-infested Pears. Mention is also made of the damp decay which sometimes accompanies the advanced state of the black blotches.

Regarding internal characteristics, we have notes of the maggot-workings, from the early condition of attack of the young Pear when only chambered around the core, up to a great part of the fruit being hollowed out or decayed consequently on the maggot injuries, this decay sometimes spreading all across the little fruit.

Notice is also taken of the escape of the maggots being from the Pears whilst still hanging on the trees, as well as after it has fallen in consequence of its ruined condition; also any means of exit may serve the purposes of the maggots, as through the openings afforded by the cracks in the fruit, or by passing out from the infested portions through the opening available at the calyx end of the Pear. The power of the larvæ of skipping about like Cheese Maggots is also noticed.

The midge which causes the mischief is a very small two-winged gnat-like fly, only about one line (the twelfth of an inch) or a little more in length of body; the general appearance greyish or black. More in detail, when seen much magnified, and as described by Mr. Meade from his own very complete observations, the head is black, with a patch of yellow hairs, on the top of which some come forward over the eyes. Antennæ (horns) yellowish brown, in the male about one-fifth longer than the whole length of the insect, in the female "about two lengths of the insect without the oviduct." Thorax (body between the wings) black, and, like the face, with grey reflections; and seen "from before, the hind part looks ash-grey, while the front part appears divided into three wide black stripes or patches, of which the middle one is triangular in shape, with a broad base in front, and tapering to a point behind where it joins the scutellum." On each side between the central and side black patches is a row of bright yellow hairs; but "viewed from behind, the whole thorax looks grey." A long tuft of yellow hairs is placed above and in front of the root of each of the wings, and the front edge of the thorax is covered with short yellowish hairs. Abdomen dark brown, clothed with long whitish hairs. Halteres (poisers) with yellowish stalks and clear white knobs. Wings dusky, clothed and deeply fringed on the hind margins with black hair. Legs brown, clothed with white hairs, more dense on the under surface.*



Wing of *D. pyrivora*, magnified.

The method of egg-laying is stated to be that when the Pear blossom-buds are so far advanced as for a single petal to show itself, the Pear Midges deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud; but, as noted at p. 88, they have been recorded by one observer as egg-laying in the open blossom. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

* For full and very clear description of the imago or perfect Gnat Midge of *D. pyrivora*, from which I have, with many thanks, extracted the above few points, see paper on "*Diplosis pyrivora*," by R. H. Meade, in the 'Entomologist,' vol. xxi. I have already given the above abstract of Mr. Meade's description at p. 122 of my 'Handbook of Orchard and Bush Fruits'; but it seems desirable for convenience of reference to repeat it here.—E. A. O.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail, with a small horny appendage, known as the breast-bone, or (from its form in some of the *Cecidomyiæ* larvæ) as the "anchor process," beneath the fore part of the body near the head end. In the Pear Gnat maggot this process consists of a narrow stalk attached at its base to one of the segments of the little larva, and pointing forward at the free end, which is enlarged to nearly twice the width of the stem, and slightly notched at the flattened or convex end.

Within the Pears the midge maggots live and feed until they have attained their full size, which may be about the beginning or middle of June, and the infested Pears may often, though not always, be known by their knobbed irregular growth and discoloured patches. At this stage—that is, when the young Pear is destroyed by the mischief within—the fruit usually cracks or falls to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting from Prof. J. B. Smith; for reference, see note, p. 91) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring."—(J. B. S.) There appears to be a difference in date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come up out of the ground in spring ready to attack the blossom-buds of the Pear.

Prevention and Remedy.—One sure method of lessening recurrence of attack is to pick off and destroy the little stunted Pears before they have reached the stage at which the maggots leave them to go down into the ground. Also it is desirable to pick up (as soon as possible) and destroy the small fallen fruit. To this the treatment of giving a thoroughly good shaking and jarring of the boughs of the infested tree, so as to shake down as much of the infested fruit as possible, *as soon as possible*, would probably be a very serviceable addition. Also if previously tarred cloth, or any rough cheap material, was spread under the boughs of the tree, so that the infested fruit and the maggots which escaped from it might all be gathered up together and burnt, or well shaken out together into a hole and well covered down, this would save much escape of the maggots.

Where the ground below the trees is free of crop, and the Pear roots not too near the surface, the plan of skimming the surface, and destroying the surface earth with its contained infestation would answer well. The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed. Any time would be suitable for this operation between the time of the falling of the infested Pears from the trees and such a date in the following winter or spring as would ensure that the cocoons should be skimmed off and destroyed in the infested earth before the season came for the development of the insect contents. The Gnat Midges appear with the Pear blossoms, but it would be well to be some weeks beforehand, and also to be sure that the earth is burnt, or in some way thoroughly got rid of with its contents.

Where Pears are grown in grass orchards it might be hoped that a deal of the infested fallen fruit would be cleared off by having sheep or pigs on the land to eat it as it falls.

The best remedy of which we have information at present appears to be (as reported by Prof. J. B. Smith) application of kainite to infested ground. In an observation on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown fifty per cent. were "midged," and of the other kind named not one could be found to have escaped.

In laboratory experiment Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of the nitrate was applied, a still lesser proportion of the maggots were found to be alive.

Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

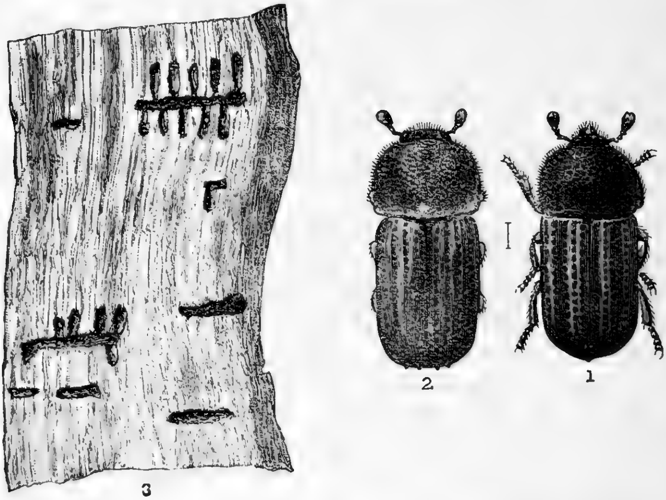
But in the case of sprinkling with a small quantity of kainite, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in the jar had ever formed cocoons, and those that did seemed all of them to be dead."—(J. B. S.) The experiment is given in minute detail in the Bulletin referred to below,* the period from commencement to

* See, for much useful information on this attack, "The Pear Midge (*Diplosis pyrivora*, Riley)," Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

final examination ranging from June 10th to October 6th, and I believe may be of great assistance to us in checking attack of this destructive Gnat Midge.

PINE.

Striped Pine-boring Beetle, *Trypodendron lineatum*, Oliv. = *Xyloterus lineatus*, Esch. **Deciduous Tree-boring Beetle,** *Trypodendron domesticum*, Linn. = *Xyloterus domesticus*, Esch.



TRYPODENDON LINEATUM.—1, male, 2, female, magnified; and line showing natural length; 3, borings in Spruce wood, natural size, showing mother-galleries and larval and pupal cells.

The two species of small wood-boring beetles mentioned above do mischief by tunnelling for a short distance into the solid timber, respectively of Conifers (in the case of *Trypodendron lineatum*) and of deciduous trees, as Oak, Beech, and Birch, in the case of *T. domesticum;* and the two species being very similar both in appearance and habits, it has seemed most convenient to give here an account in detail of the Pine-boring kind, with the addition of some notes of the distinguishing points of *domesticum*, rather than place this under a separate heading.

These attacks have not been previously reported to me, and I was much indebted to Mr. James R. Robertson (Chatsworth Estate), Edensor, Bakewell, Derbyshire, for being good enough to give me a few observations, together with specimens of both kinds of beetles, also of larvæ and pupæ, and specimens of tunnellings of *T. domesticum* in felled Oak.

The observation of *T. lineatum* in England (as distinguished from Scotland) appears to me to be of a good deal of interest, as, so recently as 1895, I find it observed that "The species is widely distributed throughout Europe, but is confined in Great Britain to a few localities in the Tay and Dee districts of Scotland, where it has not yet proved injurious."

I find also the following by the excellent authority the late E. C. Rye, F.E.S.,* of his personal observation of it in Scotland, in wording that seems to point to his not considering it to be an English species:—

"*Xyloterus lineatus*, an elegantly striped insect, with more pretensions to beauty than its allies, is found (rarely) in Scotland. I have seen it with its head and thorax protruding from its neat circular drill in the solid wood of felled Pines; but it is oftener seen than taken, owing to its habit of backing quickly to an indefinite depth into its burrow on the approach of the bark knife. In this species the antennæ have a rounded club, whilst in the other (*domesticus*) the club is pointed."—(E. C. R.)

From the above passage, and also from only the above-named two species being noted in his list of British beetles (p. 265 of work referred to in note), it would appear that then and up to 1890 (the date of the second edition by the Rev. Canon W. W. Fowler, F.E.S.) only these two species were recorded *as British.*

But it should perhaps be just noticed that there is yet another species, the *Trypodendron* (= *Xyloterus*) *quercus* of Eichhoff, which is mentioned by him † as infesting the wood of various deciduous trees, and which is very shortly referred to by Prof. Fisher, in the work mentioned below (p. 232), as much like *lineatum* in appearance, but distinguishable by the club of the antennæ being *angulate* at the extremity. In this respect, as well as in its habits, it is stated to resemble *T. domesticum*, "but is much less common in Britain, being almost entirely confined to the neighbourhood of Sherwood Forest." ‡ From the exceedingly small amount of presence with which this species is credited in England, it seems hardly worth while to refer to it, excepting relatively to the confusion regarding the nature of trees attacked by *T. lineatum*, the *really*, *solely* Pine-boring species, which is considered by Herr Eichhoff wholly to have arisen from insufficient

* Rye's 'British Beetles,' first edition, p. 198.

† See 'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 296.

‡ See 'Dr. Schlich's Manual of Forestry,' vol. iv. p. 232, by W. R. Fisher, Assistant Professor of Forestry, Royal Indian College, Cooper Hill, &c.

discrimination between the two kinds, *lineatum* and *quercus*. And perhaps I should add that, perceiving the difficulties of perfectly certain determination, I submitted my specimens to examination of Mr. O. E. Janson, F.E.S., who verified my identification as correct.

The communications with which I was favoured by Mr. J. R. Robertson, from the Chatsworth Estate, of which the first was sent me on June 28th, were as follows:—

"I have been considerably troubled for the last few weeks by the damage being done to some Oak timber that has been felled for about eighteen months by larvæ that I think belong to the *Scolytus* or *Bostrichus* type. . . . The damage is considerable, the timber being quite riddled with small holes to a depth of two or three inches. The holes look as if they had been made with a small gimlet, and a tiny heap of small fine sawdust left at the outside of each. I am sending you by this post a box containing the larvæ *in situ*."—(J. R. R.)

About a week later—that is, on July 5th—Mr. Robertson communicated with me again, mentioning that he now observed beetle infestation of a similar nature in some felled Larch timber lying close to the Oak which he first noticed as attacked, and forwarded me specimens of pupæ, and also of the fully-developed beetles.

These beetles were in very active condition, and corresponded well with the description of the Pine-boring kind, *T. lineatum*. They are very small, only about a quarter to a third of an inch in length, and of the shape figured at p. 92—that is, somewhat straight-sided and cylindrical. The thorax punctured and black (customarily), dull yellow-brown towards the hinder margin; the wing-cases dull yellow-brown, with a black stripe running along each at the suture, the outer margin, and characteristically also along the middle; but in some cases this line or stripe is partly absent. In my specimens it was represented by some marks towards the base of the elytra. The wing-cases are also marked with rows of punctures. The legs are dull yellow-brown, as also the antennæ, which are terminated by a *rounded club*.

This species is liable to differences in colouring, and three varieties are noted by Eichhoff, of which the most distinct has the whole body pale brownish yellow, with a blackish head, and fore edge of the thorax ("Halsschild") and the breast duller.

With regard to the kinds of trees infested by this species, it is observed:—"These beetles, which live exclusively in needle-leaved trees (*Coniferæ*), are distributed over almost all Europe, and are also . . . . to be found in North America. Amongst different kinds of Conifers (*Pinus sylvestris*, *Abies excelsa* and *pectinata*, and *Larix europæa*) they appear, where they have the opportunity, to especially select the Silver Fir (Weisstanne). What Ratzburg and Altum, and to some degree Gyllenhal, report regarding its occurrence in Birch and other deciduous-leaved trees rests undoubtedly on confusion with the preceding kind" * [namely, *Trypodendron quercus*, Eichhoff, the Striped Deciduous Tree-borer, E. A. O.].

With regard to larval and pupal description, I copy that of Dr. Taschenberg:—

"The larva is white; the place of the claw-feet being taken by six short conical lumps. The brown head is furnished with strong mandibles. As long as the larva lies in its nest, rolled together with the head near the tail, the lower part is pressed smooth, and the back arched. . . . Half of May and June, afterwards half of August, September, in wood.

"The pupa is white, slightly shining on the thorax, otherwise dull, and on both sides of the body set with 4–5 hook-like teeth directed backwards and inwardly, the foremost of these being the smallest. Length of the body 3·5 millimetres. They remain on an average fourteen days in their cradles, with the head turned towards the mother-gallery." †

So very little detail (as far as I am aware) has been recorded from original observation of the life-history in Britain of this and the allied species, *T. domesticum*, that I have thought it best to extract some of the chief points from the enormously elaborate papers of Herr Eichhoff and Dr. Taschenberg, hoping that the infestation being thus brought forward may lead to further investigation.

The method of infestation of this species to Pine timber (as given by Prof. Fisher, p. 229 of work quoted, *ante*, p. 93) is stated to be for the mother beetle to bore straight into the tree for a short distance, and then to construct one or more brood galleries at the end of the entrance tunnel, usually at right angles to this entrance burrow, and always transversely to the long axis ‡ In the floor and roof of these galleries the mother beetle gnaws small cylindrical holes vertically into the wood for the reception of the egg, and after oviposition she blocks these holes with wood-dust, forming partitions between the secondary and primary galleries. There are generally from thirty to fifty eggs.—(W. R. F.)

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 299.

† The above description is taken from the elaborate account of this species given by Dr. E. L. Taschenberg in 'Praktische Insektenkunde,' pt. ii. p. 234, under the synonym of *Xyloteres lineatus*, Ol.

‡ These burrows I have not had the opportunity of examining in Pine timber, but, judging by comparison of figures and descriptions, they may be generally described as somewhat in shape like a capital Y or T laid horizontally, the stem of the letter representing the perforation of the mother-gallery made from the outside of the tree, and the arms, one of which is often missing, or very variously twisted or modified, representing the brood galleries.—E. A. O.

The figure of borings of *T. lineatum* in Spruce wood, copied from Mr. Fisher's paper, given at p. 92, conveys an excellent idea of the galleries, as seen in a vertical section of Spruce wood; and accompanying (p. 230, same paper) will be found a figure of a *horizontal* section of Spruce wood showing the entrance galleries and branching brood galleries, of which I have endeavoured to convey the appearance above by comparison with letters.

The mother-galleries of *T. domesticum* (the species infesting deciduous-leaved trees) are stated not to branch (as a rule), and in the good supply of specimens of borings of this kind into Oak timber, with which I was favoured from Chatsworth, I found that the mother-gallery, with the little upright larval cells gnawed out above and below, would be perfectly well represented by the figure of *lineatum* at heading (p. 92).

The larvæ are observable in May, and beetles are to be found about the middle of July or earlier, ready to give rise to a second brood. The specimens of *T. lineatum* (in imago state) were sent me on July 5th, those of *T. domesticum* on June 28th, and in each case pupæ, or larvæ just on the point of turning to pupæ, were sent accompanying, showing that the summer brood was then developing. It is considered on the Continent that there may be three broods in the course of the year, and that, failing other shelter, some of the last brood hybernate in moss at the root of trees.

Trypodendron domesticum, Linn., the *Deciduous*-leaved Tree-borer.—The main distinctions of the beetle, as abridged from Eichhoff's description, are that it is somewhat elongate-cylindrical, black, with straw-coloured antennæ, feet, and wing-cases, the latter with darker suture, edge, and extremity; finely punctate-striate, and furrowed on both sides of the suture at the apex. There are occasional differences in detail of colour sufficiently marked as to be classed as four varieties, but requiring with such small beetles magnifying powers to ascertain them exactly, excepting perhaps in the case of the variety of which the whole of the wing-cases and the legs are of a clear (or pale) yellow.

The life-history of this species appears to be very similar to that of *T. lineatum*, excepting in the point of it infesting the timber of deciduous (or, as they are termed, broad-leaved) trees, as Oak, Beech, Birch, and Lime; *not* that of Conifers, or "needle-leaved" trees. Also the mother-galleries do not appear to be always branched.

This species is recorded as to have been noticed even as early as February 20th in great numbers in a warm spring; but in this case it is noticed the "swarm," so to call it, would retire again, without carrying out infestation, into crevices in bark, or under moss or leaves, where the observer had often found the beetles during winter. Commonly they are stated to come out first in March, or, in a late spring, it may be firstly in April, for breeding purposes. It is noted, however, that it is in July at the latest that (in regular course) the first generation will be found ready for flight, and then, and in August, newly-laid eggs are again to be found in the brood galleries. The beetles that thence originate from these eggs remain during winter in the place of their birth, where Herr Eichhoff notes that he has seen them often in imago state from November till March.

Prevention and Remedies.—Where the beetles of *T. lineatum* have the option, they as a rule avoid "barked" * stems for egg-deposit, especially when, at egg-laying time, the outer layer has become more or less dry. But where this is still juicy, or damp from situation, or other circumstances, then the stems which have been stripped of their bark are liable to attack. Sickly coniferous trees are liable to attack, and (with both species of beetle) broken wood and windfalls, or stumps, are particularly liable to infestation. It is therefore advised that these should be barked if their entire removal is not practicable.

Much stress is laid on removal of the bark as a deterrent of attack, but it should perhaps be noticed that in the case of this infestation the removal of the bark is only a *preventive* measure, and *not a remedy*, as it is in the case of our two great bark pests, the "Elm-bark Beetle" (*Scolytus destructor*) and the "Pine Beetle" (*Hylurgus piniperda*), in which the beetles breed just within the bark, so that removal of the nursery-ground gets rid at once of the nursery and its contents. With the wood-boring Trypodendrons, the stripping of the bark only acts by making the surface of the wood below it too dry to invite infestation.

Where the beetles are very prevalent, trees from which the bark has been taken may be attacked, and where this is to an extent that makes preventive measures desirable, this wood should be removed before March—that is, before the time of flight of the spring brood of beetles. Felling in the growing season and immediate removal of the bark is advised as a preventive.

Traps may be arranged of wood felled for the purpose, or of waste wood left about in July and August (the summer breeding-time) to attract the beetles to lay their eggs instead of infesting valuable wood. But these trees or branches should be kept under careful examination, and when found to be attacked, should be stripped of their bark and split up to destroy the larvæ in the wood.

The attacks are said to be worst where there are winter fellings, presumably from the felled tree-trunks being in favourable condition at return of spring for attack of the spring brood of beetles.

* Perhaps for foreign readers who may favour me by looking over this paper, it may be as well to mention that a "barked" stem is *not one with bark on it*, but one from which the bark has been taken.

Where the beetles are numerous the infestation is liable to cause great loss by the perforations in the solid timber, but as yet (so far as I am aware) we have not much of what may be called "commercial observation" of this in Britain, *i. e.* little complaint of damage, and (in case trouble should arise) we greatly need to have more observations *from foresters in this country.*

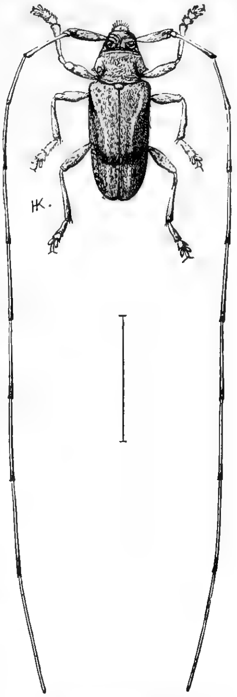
The attack is entered on in most elaborate detail by skilled German writers of the highest standing, but the accounts do not always wholly agree, and in my endeavour to give a reliable history of these bark beetles by collation of many publications I have met with such difficulties that I offer it under submission to corroboration in some (though perhaps not very important) points of detail to future practical *British* observation.

We need (I believe) notes of what the time is (in this country) of the appearance of the successive broods of the beetles; that is, what is the date in spring, and also whether besides the summer brood there is a third in autumn. Also more information as to amount of attack, and of preference of the beetles for egg-laying on felled or sickly trees, &c., and how far removal of the bark acts as a trustworthy preventative of infestation. Also there is a difference in statements as to the customary form of the brood galleries in *T. domesticum;* also as to whether *T. lineatum* wholly confines its attacks to the wood of coniferous trees. If we had information on these points from foresters accustomed to observation, so that we might know definitely what *does* take place in different localities, it would much facilitate dealing with the attack, should it prove on trustworthy practical investigation to require attention.

I may perhaps be allowed to add that, as a comprehensive digest of information up to date of publication, a very serviceable amount of entomological and practical information will be found at pp. 228–232 of Prof. W. R. Fisher's volume on 'Forest Protection,' for reference to which see *ante*, p. 93.

Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.

This very remarkably "long-horned" beetle may perhaps deserve a slight notice again this year, as, although in almost all instances mentioned, the specimens reported were probably from imported timber, yet it is becoming a little more observed than was formerly the case.



Astynomus ædilis, slightly larger than life; line showing nat. length.

The only specimen which I have as yet received, which might in all probability be considered of British origin, was a fine male beetle, with the antennæ (which are often injured consequently on the fighting propensities of the insects) in beautiful order. This was captured on August 12th, 1895, on the farm at Kinnaird, Strathpeffer, Ross-shire, N.B., and reached me alive, so as to give me an opportunity of studying its very graceful appearance as it walked gently about bearing its delicate horns, about half a foot in expanse from tip to tip, lightly arched at right angles to its body, of about three-quarters of an inch in length.

The second specimen was sent me on September 2nd, 1897, and was caught in a coalmine two and a half miles from the bottom of the shaft, and sent me from near Morpeth, Northumberland. In this case I suggested that in all probability it had been imported in timber used for workings in the mine, and my correspondent replied:—"Your suggestion that the beetle came from the north of Europe is quite correct, as the wood (Fir) used in the mine is brought from Norway."—(W. W.)

In the past season Mr. H. L. Leonard, writing on September 21st from Preston, Hull, forwarded me the third specimen, which I have received, with the remark accompanying:—"My wife caught the enclosed insect on the table the other day; no one whom I know can tell me what it is. . . . Will you kindly tell me its name, and also if it is uncommon?"

There was no entomological difficulty in identifying the specimen as being a (so-called) Timberman Beetle, *Astynomus ædilis*, L.; and in reply to my letter Mr. Leonard wrote further on September 23rd:—"I think I did not tell you that a Hull merchant found one of the same variety of beetles in his office last week. It would probably be a male, as the horns were fully an inch longer than my specimen.

If he still has it, I will get the measurement of the horns, which I fancy would be about two and a half inches long."—(H. L. L.)

The enormous length of the antennæ, and especially of those of the male beetle, are the chief characteristic of this species, of which it is stated by Dr. Taschenberg that it has in the male the longest horns which are known to occur in any European kind. In this sex they are from three or four times to as much as five times the length of the body, or, by measure, may be as much as about three and a half inches long. The horns of the female are much shorter, being only about twice the length of the body of the beetle, which may vary from about half to three-quarters of an inch.

The shape of the beetle is as figured (at p. 99, magnified) from the specimen sent me from Strathpeffer, somewhat flattish above, and the general colour of a brownish ash, or "smutty violet grey," and it is clothed with a greyish pubescence. The thorax has one blunt tooth on each side (see figure), with four much smaller ones above placed transversely in front.

The wing-cases have numerous black spots, arranged to some degree in rows, and are marked by two somewhat oblique brownish bands, the front one in the specimen figured only extended a little way from the outer edge. Legs chiefly grey or brownish, with grey down.

The beetle is found on the Continent in great numbers, and the grubs live in the wood as well as under the bark of fallen Pine stems. Also it is noted that "the larva makes wide galleries and perforations in Pine stumps, forming a nidus, with coarse gnawed fragments near the surface, in which it changes to pupa. . . . The larva appears to be full-fed at the beginning of the summer, and after remaining two or three weeks in the pupa state, changes to the perfect state, staying as such in its nest until the following summer." * The beetle is noted as being observed in great numbers after hybernation in early spring in forest clearings; and another continental observer mentions having himself taken thirty beetles in one morning in a woodyard about Pine wood.

As yet, in this country, however, the only locality where it appears to have been observed as not uncommonly present is at Rannoch, in Perthshire, and it cannot be said as yet to rank amongst the really injurious beetles of Britain. But, like the species noticed in the preceding paper, the grubs have certainly a capacity for doing mischief by feeding in fallen or felled Pine timber, and it may be well to draw attention once again to the occasional presence of the beetle as an infestation that may cause trouble.

* 'British Beetles,' by E. C. Rye, F.E.S., p. 208.

POTATO.

Potato-stem Borer. *Hydrœcia micacea*, Esp.*

On July 20th, in the past season, Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, N.B., to whom I have been previously indebted for very carefully observed notes of insect attack, forwarded me some observations of damage caused to Potato stems (to a serious extent) by the borings of a kind of moth caterpillar within them, of which he forwarded a sample.

The piece of Potato stem sent accompanying was bored for about seven inches. That is, the boring sent was about that length, but it might have been longer, as the stem was cut through at the lower part, so that some of the tunnelling was removed. At the upper part there was some frass from the workings of the caterpillar. With this, and the moth caterpillar accompanying, Mr. Sim sent the following notes:—

"I beg to enclose you specimen of larva which is not described, to my knowledge, in your works on injurious insects. They are destructive to the growing crop of Potatoes, especially in gardens, and perhaps the failure of that crop may be sometimes due to them. I have observed some extent of damage done here every season for some years, but I am not aware what is the originator of the evil. When the Potatoes are in a growing state, and the haulms nearly at the full height, a plant may be seen here and there with leaves withered up and the stem fallen over. A careful examination of the prostrate plant with hollow stem invariably shows that the damage is due to the enclosed pest, which is found feeding inside."

On August 9th Mr. Sim sent me the following communication, which it will be observed is of interest as giving the approximate date of the termination of attack:—

"I have looked over the Potato crop as you advised, and have found in the fallen stems a few more of the destructive grubs like the specimen I sent you. Their season of work is now over, but I will try and rear a moth for you."

On October 17th following, Mr. Sim was accordingly good enough to send me specimens of the moths, with the note of these moths being reared from caterpillars taken from injured Potatoes, also the date of pupation and the date of the appearance of the moths, as follows:—

"I have much pleasure in sending the Potato moths which I have

* A description of the moth, which is known popularly as the "Rosy Rustic," will be found at p. 103; but it is not figured, as the specimens (apparently from circumstances noted) were stunted in growth.

bred for you, and I have no doubt you will be able to identify them. The caterpillars of the enclosed specimens were taken in the field from injured Potatoes in the end of July, when the larvæ were about half grown. They pupated in the third week of August, and the moths appeared in the middle of September. The disease makes its appearance first in the garden among the early varieties, afterwards in the field among the later sorts. The Potatoes appear to be liable to the attack during the whole period of active growth. When late and robust growing varieties are attacked, the stems do not fall down like the earlier sorts, but may be seen standing erect after they are withered and dead."—(W. S.)

As I could not myself feel sure that I was able to identify the species quite certainly, and it was of very practical interest to be sure in the matter, I ventured to submit the specimens to Mr. Richard South, F.E.S., who was good enough to reply that he was inclined to think they were "rather small and very dark examples of *Hydrœcia micacea*, Esp." Mr. South added:—"This species is known to feed in larval stage in Dock and species of *Equisetum*. So far as I am aware, the fact of this larva feeding in the stems of Potato is new, but I remember that a grower at Macclesfield told me that a 'grub' (which from his description ought to have been a *Noctua*) affected his Potato crop."—(R. S.)

On June 15th in 1892 I had myself had inquiries sent me as to the nature of an attack to Potato haulm corresponding with that reported above, and similarly caused by a *Noctua* moth caterpillar—these respectively, in one case, from Melton Mowbray; in the other, from Daleally, Errol, N.B.; but unfortunately I was not able to procure specimens of the moth to which the larva developed, for identification. From the nature of the injury, however, and the appearance of the larva, I *conjectured* the kind to be *Gortyna flavago*, a species exceedingly nearly allied to *Hydrœcia micacea*, and the moths of the two species similar in size, and likewise of similar variation in size (see Stainton's 'Manual of Butterflies and Moths,' vol. i. pp. 196, 198); and at p. 119 of my Annual Report for 1892 I noted that it seemed "scarcely open to doubt," so far as I could judge from the points available for investigation, that the grubs were of *G. flavago*.

As the Potato-borer, of which we have since had specimens, proves almost certainly to be *H. micacea*, it would be of very useful interest in case Potato crops are still injured by stem-borers at Melton Mowbray, and near Errol, to have complete observation by which we might make sure of the kind specifically, and I give the following description of the larva of *H. micacea* from Newman's 'British Moths,' p. 282:—

"The body is soft, fleshy, and maggot-like, the segments being distinctly marked, each has sixteen or eighteen minute black warts, and each wart emits a minute but rather stiff black bristle; there is a corneous glabrous plate on the second and thirteenth segments; the colour of the head is testaceous red, of the body greyish flesh colour, with a very narrow darker medio-dorsal stripe; the dorsal has more colour than the ventral surface, which has a glaucous or bleached appearance; . . . the legs and claspers are nearly concolorous with the ventral area."—(E. N.)

When three-quarters grown—that is, an inch and one-sixteenth in length—the larva is described by William Buckler * as somewhat darker in the general colouring, especially that of the upper part. "The colour of the back and sides down to the spiracles was a rather deep purplish red-brown without gloss, and a little paler on the thoracic segments and at the divisions; the sides below the spiracles, the belly, and the legs were paler, and of a dingy flesh colour; the head ochreous brown, and mandibles blackish brown; a polished pale ochreous brown semicircular plate on the second segment rather broadly margined in front with blackish brown; a small shining pale ochreous plate on the anal tip, having a terminal border of very small dark warts. . . . At the beginning of July the larva had attained an inch and three-eighths in length, . . . having meanwhile gradually grown paler on the back; and by the 10th of the month the upper and under surfaces were both alike of a deep smoky dull flesh colour. In this case the larva had fed on *Equisetum*, popularly known as 'Mare's-tails,' or 'Cat's-tails'; but at this date it ceased eating, and excavated a hole in the earth at the side of its pot, in which, by the fifteenth, it changed to a light ochreous brown pupa, three-quarters of an inch long, from which the moth emerged on the 14th of August."—(W. B.)

The moth is from an inch and a quarter to a little over an inch and a half in expanse of the fore wings, which are variously described as of a pale brown ground colour, with a rosy tinge, or of a "rich reddish brown"; on the wing is a "broad dark patch," otherwise described as a "broad median band," the outer portion being "very rich dark brown." Hind wings "whitish grey with darker central line," or "dingy grey brown with a darker crescentic discoidal spot, and transverse median bar"; the antennæ nearly white.

On communicating with Mr. Sim regarding the unusually small size of the *imagos*, which he had been good enough specially to rear for, and to send to me, he replied, on Oct. 27th:—"It is very probable that the specimens which I bred would be dwarfed, as they were only half-fed when I found them, and their food was only replaced on two occasions." But with regard to further observation, Mr. Sim con-

* See 'Larvæ of British Butterflies and Moths,' by the late William Buckler, vol. iv. p. 51. Ray Society.

sidered there would be no difficulty on this head, for the attack might be expected to occur again as it had in previous years.

In regard to measures of prevention or remedy, we do not at present appear to have knowledge of any that would be at all applicable, unless it might happen that in gardens where spraying is adopted to keep off "Potato disease," that the chemical dressing would prove deterrent if used sufficiently early in the season.

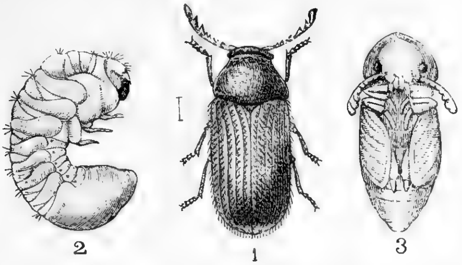
The difficulty lies in the fact of the caterpillar turning customarily (as noted in German observation) to chrysalis state in an earth-cell *in the ground* in July; from which the moth is recorded by British observers as appearing in August and September. This puts the date of development too early for breaking up the ground to be available (as a general thing) so as to throw out the pupating caterpillars. Consequently there is no obvious method of dealing with the attack as there is with *Gortyna flavago* with which the caterpillar pupates in the Potato stem.

Further information on the attack might prove also of serviceable interest *relatively to Hop attack*, as it is noted by Dr. Fletcher that a nearly allied kind, *Gortyna* (=*Hydrœcia*) *immanis*, does much harm in Ontario (Canada) by means of its caterpillar boring the leading shoot of the Hops, and causing a disease known as "Bull-heads." *

* See "Notes on Injurious Insects," by James Fletcher, in 'Insect Life,' U.S.A. Department of Agriculture, vol. v. p. 125.

SEEDS, STORES, AND WOOD.

Bread or **Paste Beetle; Drug Store Beetle** (U.S.A.). *Anobium paniceum* (=*Sitodrepa panicea*), Linn. **Striped Death-watch Beetle.** *Anobium striatum*, Oliv. **Checkered Death-watch Beetle.** *Anobium tessellatum* =*Xestobium tessellatum*, Fab. (=*X. rufovillosum*, De G.*).



ANOBIUM PANICEUM.—1, beetle; 2, larva; 3, pupa, magnified. (From Bulletin No. 4, New Series, U.S.A. Department of Agriculture, p. 124.)

During the past season I received inquiry from one of our chief seed and importing firms regarding some insect infestation in Onion seed, noticed in South Africa in seed that had been imported from England. Specimens were placed in my hands for examination which showed the damage to be caused by the maggots of a small beetle, apparently some kind of *Anobium;* but (necessarily) what the species might be could not be told from merely *larval* specimens. On development, however, to beetle condition, the species was found by the Assistant Government Entomologist, Cape Colony, to be *Anobium paniceum* (now known as *Sitodrepa panicea*), a kind with which I had made acquaintance some years ago, as seriously injurious to leather of boots exported from England to Cape Town, and to Port Elizabeth, South Africa.

From the extraordinary variety of kinds of substances on which this widely distributed pest preys, it appears almost impossible to name it usefully under the name of any one of these; but as (amongst these) granary and mill stores, likewise dried Peas and Beans, are subject to its ravages, and we have now an instance of its power of injuring Onion seed, the infestation may fairly be classed amongst agricultural pests under the above heading of "Seeds and Stores," joined to that of "Wood," to which the other two species of *Anobium* named cause inconvenient or sometimes almost ruinous damage by their perforations in furniture and beams and other solid woodwork.

* Third Supplement of Henshaw List.

The figure, p. 105, gives a very good representation of *A. paniceum* in its various stages,* and may be taken as a guide to the general appearance also of *A. striatum* in its successive conditions, and to *A. tessellatum* in larval and pupal state. In beetle state this last ranges to fully half as much or more in length than the two other kinds named, and is distinguishable further by being patched or "tessellated" on the wing-cases with yellowish down, whence its specific name.

Anobium paniceum † is about one-tenth of an inch or rather more in length, of a uniform light brown colour, and covered with fine grey down. The following is a detailed description:—Oblong, convex; reddish brown, and closely covered with very fine short grey pubescence. The head is deflexed and concealed beneath the front margin of the thorax; the antennæ have the basal joint rather large, the second smaller, the six following very small, and the apical three very large and rather more than twice as long as broad. The thorax is very convex and finely punctured, a little wider than the elytra at the base, rounded at the sides, somewhat compressed in front, and slightly impressed on each side at the base. The scutellum is small and nearly square. The elytra are straight at the sides, rounded behind, and have ten impressed rows of fine punctures on each; there is also a short and slightly oblique row of similar punctures on either side of the scutellum, the interstices between the rows of punctures are flat, and have indistinct transverse scratches. In fresh and perfect specimens the pubescence is very close, and imparts a dusty appearance to the surface; there are also some longer hairs between the rows of punctures on the elytra, but in old and worn specimens the surface is frequently more or less denuded of hairs, and has a much more polished appearance. The length of the body is from three to three and a half millm.—O. E. J. ‡

The larvæ are white and curved, and resemble those of other *Anobia*, and are not unlike Chafer maggots in miniature. They are soft, cylindrical, fleshy, and slightly pilose, with a scaly head (armed with robust-toothed jaws), and have six legs.

With regard to the food of the maggots (quoting again from the U.S.A. Bulletin referred to in note below, which is the fullest record

* This figure I acknowledge with many thanks as copied (somewhat reduced) from the greatly magnified figure given in 'The Principal Household Insects of the United States,' by L. O. Howard and C. L. Marlatt, p. 124. Bulletin No. 4. United States Department of Agriculture, Washington. 1896.

† *Anobium* being the name under which this genus has been chiefly referred to for many years, I continue to use it for convenience of general reference, giving the synonyms of *Sitodrepa* and *Xestobium* where requisite.

‡ See p. 13 of my small volume 'Some Injurious Insects of South Africa,' in which the technical descriptions of the insects are by Mr. Oliver E. Janson, F.E.S.

with which I am acquainted), it is said:—"In Europe it is still known as the Bread Beetle, but its chief injuries are to druggists' supplies, hence the name of Drug Store Beetle. Its depredations do not stop here, however, for it invades alike stores of all kinds, mills, granaries, and tobacco warehouses. Of household wares its preference is for flour, meal, breakfast foods, and condiments. It is especially partial to red pepper, and is often found in ginger, rhubarb, chamomile, boneset, and other roots and herbs that were kept in the farmhouse in our grandmothers' days. It also sometimes gets into dried beans and peas, chocolate, black pepper, powdered coffee, liquorice, peppermint, almonds, and seeds of every description."

Drawings, paintings, manuscripts, and books are in the catalogue of its dietary; and, again quoting *verbatim*:—"In pharmacies it runs nearly the whole gamut of everything kept in store, from insipid gluten wafers to such acrid substances as wormwood, from the aromatic cardamom and anise to the deadly aconite and belladonna. It is particularly abundant in roots, such as orris and flag, and sometimes infests cantharides." Various other subjects for depredation are mentioned, including gun-wads, likewise injury to boots and shoes, to which item I may add that I have personally (as noted further on, with a figure of injured material) only too certain knowledge of the injuries of the pest in the case of boots exported to South Africa.

The method of feeding of *A. paniceum* is stated to be that "the larvæ bore into hard substances like roots, tunnelling them in every direction, and feed also upon the powder, which soon forms and is cast out of their burrows. In powdery substances the larvæ form little round balls, or cells, which become cocoons, in which they undergo transformation to pupæ, and then to the perfect insect. . . . There may be at least four broods" [in the course of the year, E. A. O.] "in a moderately warm atmosphere." *

Amongst the subjects of attack specified above, it will be seen that "seeds of every description" are specified; and relatively to this item, the following communication was sent me on March 28th in the past season from one of our leading nursery and seed establishments:—

"May we ask your assistance in the following matter? A customer of ours in South Africa has just sent back the accompanying packet of Onion seed, which you will see is badly attacked by a weevil or maggot of some kind. When the seed left our hands last October, it was perfectly free from anything of the sort, while some of the same parcel

* I have ventured to extract the above at length as a list of the enormous variety of substances preyed on by this widely distributed pest, given on the high authority of the officials of the U.S.A. Department of Agriculture (see reference, p. 106, *ante*) cannot fail to be of great serviceableness to all who suffer from, or are called on to investigate, the ravages.—E. A. O.

remaining in our stores is still sound and good. Our client's suggestion is that the weevils must have generated in the seed; but we are inclined to think that they found their way in from the outside, seeing that the packet has been perforated."

On examining the packet of seed, I was struck with the resemblance of the little larvæ to miniature Cockchafer maggots, which is a kind of general characteristic of those of *Anobium;* and after investigation I replied that they appeared to me to be larvæ of *Anobium*, but of course of what *species* I could not say until the beetles from them developed. I was aware from previous experience that there was sometimes much mischief in Cape Colony from *Anobium* attack, and much trouble from the infestation being without cause attributed to the *exporters*. In this instance, from the high standing of the exporting firm, and the evidence as to some of the same parcel of seed remaining in their hands still continuing good, and also the fact of the seed packet returned being perforated, there appears to me to be little if any doubt that infestation was not sent in the seed from England.

With regard to identification of the species, we had the benefit of this in a communication from Mr. Claude Fuller, Assistant Entomologist of Department of Agriculture, Cape Town, Cape Colony, to whom some of the infested Onion seed was submitted for examination. Mr. Fuller wrote at length, and I extract the following notes from his letter of May 3rd:—

"During transmittal a few of the 'maggots' have matured, and the beetles prove to be the well-known 'Paste Beetle,' *Sitodrepa panicea*, sometimes referred to as *Anobium*. This, therefore, confirms the opinion of your esteemed entomologist, Miss E. A. Ormerod. In view of the fact that this insect is almost cosmopolitan, and not being acquainted with the circumstances of its delivery after leaving your stores, I can venture no opinion as to where the seeds became infested. The following reference to its food habits is quoted from a report presented to the Colonial Secretary of this Colony by the Entomologist, dealing with the injury the insect is doing to the bindings of many volumes in the Colonial Archives:—'This insect is remarkable for feeding upon a great number of substances differing greatly in character. It is a common pest in chemists' shops, feeding on dried drugs. It is not uncommon among dried plants and seeds, stored grain of various sorts, and articles containing paste. In this country it is well-known to boot and shoe merchants from the injury it does to their stock. Such injuries are reported from Australia and America as well.' Another authority says of it that 'it will eat anything except cast iron.'"—(C. F.)

At present, although this infestation is (or may be) a cause of loss to English growers and exporters by attacking their consignments of seed, I am not aware of it as a home trouble. If it should appear here, it would be worth while to try what kinds of steeps or dressings would check progress of the mischief without lessening vitality or power of germination of the seed. Experiments on this point made by some of our large firms who have expert advisers might be very useful to themselves for communication to their consignees.

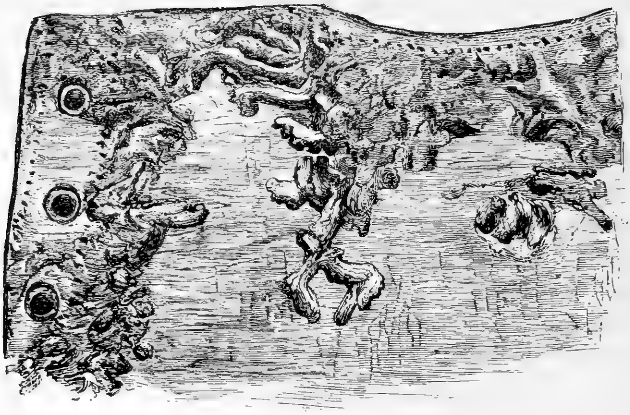
Alum has long been known as destructive to this kind of maggot, but I have no notes of its coincident effect *horticulturally* considered, and various other applications which might (harmlessly to the seed) be of service are probably too well known to need mention.

But this special seed infestation, in which the treatment would lie in skilled hands, might prove to be one in which the use of fumigation with bisulphide of carbon would do everything that is needed. We know of it as a remedial measure constantly used in Canada and the United States, and I give one of the most trustworthy recipes with which I am acquainted for method of its application to infested flour, but which would only need a little adaptation for other infested materials:—

"A small quantity of the chemical is sufficient for the disinfection of a barrel of flour, as the insects for the most part live only in the flour at the top, being unable to withstand the pressure of a large weight of material. From a half to a whole teacupful (about two to five ounces) of the bisulphide will prove sufficient for the purpose in an ordinary case, provided the cover be replaced as tightly as possible. In more severe cases of infestation it may be necessary to repeat the application. The bisulphide is poured into shallow pans, or plates, placed upon the top of the infested mass, and the receptacle covered as closely as possible, and left for a day or more. This chemical is extremely volatile and, being heavier than air, descends as a gas, killing such insects as the material may contain. When an entire room or building is overrun with insects, the bisulphide is evaporated at the rate of a pound to every thousand feet of cubic space. The vapour of the chemical is deadly to all animal life, but there is no danger in inhaling a small quantity; and although it has a powerful and disagreeable odour, this soon passes away without any after effects, and without harming for food such material as it may be used upon. The vapour is also inflammable, but if no fire, as, for example, a lighted cigar, be brought into the immediate vicinity until the fumes have entirely disappeared, no trouble will be experienced."

The above stands on the high authority of Dr. Howard, Entomologist of the U.S.A. Department of Agriculture, and Mr. C. L. Marlatt, First Assistant on the Entomological Staff; and as the advice to use this application is still regularly continued both in the United States and Canada without reports of accidents, and also, as far as I am aware, without injury to seed, I do not feel right in not inserting mention of it. Nevertheless, I should say care was needed not only for personal safety, but also possibility of vitiating insurances.

During the years 1885 and 1886 I had a good deal of communication from manufacturers and exporters at home and recipients of goods at Port Elizabeth, South Africa, regarding injury caused to exported boots by insect-workings, which, on investigation, proved to be those of the above-mentioned beetle, *Anobium paniceum*, which was present in all its stages, larval, pupal, and as perfect insect, in the injured manufactures.



Piece of a boot injured by maggot of *Anobium paniceum.*

The above figure (taken from a portion of one of a pair of child's boots sent me as a sample of the nature of the damage) shows the appearance of the maggot-galleries, which were for the most part where paste had been used between the linen and leather, but in some places had run considerably further on. The great injury and consequent losses made the matter the subject of much consultation at the time, in the course of which I was greatly obliged to Dr. Bernard Dyer, of Great Tower Street, London, for favouring me with analyses of the ingredients used for forming paste that would be *in*-nutritious to the infestation, and therefore (it might be hoped) would be preventive of the attack.

But from the consultations of the firms being in business confidence, and involving important trade interests, I did not feel free to enter on the matter for publication at the time, and now only allude to it as another instance in which this "Paste Beetle," "Drug Beetle," "Boot Beetle" (or whatever other name it may be noted under, according to special method of attack), has a power of carrying absolute devastation before it, besides losses, and also unpleasantnesses arising between the exporters and importers concerned as to where blame of insect infestation is to be laid.*

Two other species of *Anobium*, namely, *A. striatum*, Oliv., and *A. tessellatum*, Fab.,† do much harm by the borings of their larvæ into woodwork, including in this, damage to chairs, tables, picture-frames, shelves and cupboards, &c., and, on a larger and still more destructive scale, to floors and woodwork of roofs, &c.

A. tessellatum has especially been recorded as causing serious injury to the timbers of houses; but from the attacks of one or other species, broadscale damage may constantly be found going on, from the beginnings of the borings of the larvæ observable as little round holes hardly larger than the puncture of a very large pin, to which attention is drawn by the wood-dust falling from the galleries, up to the last stage of injury, in which the wood has been pierced and riddled until it is in a state to fall to pieces at a touch.

Inquiry is not unfrequently sent me as to methods of checking these kinds of attacks, but I am not aware that the precise method of commencement of the operations of the insect has been given, and the following observations, taken *by myself* some years ago, of the *modus operandi* in the case of *A. striatum*, may be of some practical interest, as showing that from the peculiar method of attachment of the egg to the attacked wood, application of deterrents might be given to the surface, or means used which would prevent the *fixing* of the egg which is the origin of the mischief.

It was during a few weeks in the summer of 1874 that I observed a great quantity of this species of beetle in a room at a house where I was then staying at Torquay, where it appeared in such numbers as to give me an opportunity of studying its habits, both at liberty and in captivity.

The figure at p. 105 gives a good idea of the appearance of an *Anobium* beetle seen from above; when noticed sideways, *A. striatum*, like most of its allies, will be seen to have the head much sunk into the thorax, which is raised at the hinder part in such a manner as to

* The matter will be found entered on in some slight degree of detail in my 'A Few Injurious Insects of South Africa,' pp. 14–17; published 1889.

† *Anobium striatum*, Oliv., is the species now often known as *Anobium domesticum*, Fourc. A good detailed Latin description of it will be found in the 'Coleoptera Sanctæ Helenæ' of the late T. Vernon Wollaston, p. 75, with the following short observation of some of the chief distinguishing characteristics of this species (at p. 76) as follows:—"The rather narrow outline and piceo-brownish hue of the *A. domesticum*, added to its nearly opaque and very minutely and *shortly* pubescent surface, and its small uneven laterally compressed prothorax, which is acutely margined towards the posterior angles, and obtusely carinated (or gibbose) on the hinder disk, will sufficiently distinguish it" (T. V. W.). For various synonyms of *Anobium tessellatum*, Fab., = *A. pulsator*, Schall., see heading of this paper, p. 105.

resemble a hood or cowl. The specimens I examined agreed with the descriptions of *A. striatum;* they were about a line and a half in length, although variable in this respect; *pitchy brown* in colour, and especially distinguishable to general observation by the retractile head and gibbous thorax compressed behind and triangularly raised above.

The wing-cases are reflexed round the edge of the abdomen, and are marked with longitudinal furrows (*striæ*), and covered with a short down. Beneath them are a pair of strong wings. The legs and antennæ are dull red.

*Observations regarding egg-laying and development of larvæ.**—" The place of deposit seems to be selected with great care; and in captivity the female may be observed moving about with the ovipositor extended, pausing from time to time for a few seconds to insert the extremity into any small hole suitable for oviposition, sometimes apparently simply for exploration, sometimes for deposit of an egg. Where the circumstances provided were tolerably natural, the eggs were always deposited singly, and I never noticed more than twelve inside the abdomen of the female *Anobium*.

" The eggs are white, in some degree transparent, and deposited with such a strongly glutinous secretion as to make it almost impossible to remove them from their position; this secretion probably playing a very important part in the insect economy by glueing, as it were, the egg both in the place and also in the exact position suitable, and apparently requisite, for the safe transition of the larva from the egg to its future shelter.

" The form of the egg varies from a perfect lemon-shape to a more or less irregular oval, corrugated for the most part, but not invariably all over, the small raised round spots being placed with great regularity, so as to give the smooth surface of the egg from which they rise the appearance of an even net-work of bands, each spot having a depression in the centre, and the number being approximately thirty-two in the circumference of the egg about a third from the extremity.

" Complete development of the contained larva appeared to take place in twenty-one days from the date of laying, and, under favourable circumstances, exclusion from the egg took place about the twenty-fifth day; but where the egg was unsuitably placed for the passage of the larva into its future food, it remained, through breaking the egg-shell, helpless within, or, if removed, equally helpless without (as far as its own unassisted efforts were concerned), towards forming its larval burrow. As far as I could gather from careful observation, it appeared that where the female beetle laid in unsuitable circumstances the larva was unable or unwilling to leave the egg, and it

* These notes are extracted from my paper on *Anobium striatum*, published in the 'Gardeners' Chronicle' for January 16th, 1875, pp. 86, 87.

remained within, breaking the shell, and moving restlessly about day after day. Where the egg had been placed naturally by the female beetle, the greater part remained firmly fixed as a protecting cap over the boring of the larva; the sides of the egg-shell and of the hole in which it was glued apparently giving points of resistance necessary for the support of the grub in beginning its mining operations. If removed and laid on material similar to that bored by a larva under natural circumstances, the removed grub was totally unable to form a home for itself till a little hole was bored for it to start in; then, having been placed conveniently for its future operations, as, for instance, with its head in the cavity, it at once went onwards, working itself forwards steadily and rapidly.

"The larva is white, with brown eyes and tips to the mandibles, six short legs, the head somewhat sunk in the preceding segment; the body sparingly sprinkled with long soft hairs, and the tail incurved; but in the only instance in which I was able to watch a specimen in the act of burrowing, it did not then preserve the incurved form, but stretched itself straight out whilst working."—(E. A. O., *loc. cit.*, *ante.*)

I had not the opportunity of watching the progress of development of the larvæ to beetle condition; but in the chapter on "Wood-boring Beetles," in the useful work quoted below,* it is stated:—"They become a chrysalis in their burrows, enveloping themselves in a silken cocoon, in which are interwoven particles of the dust they make. On emerging from the chrysalis they remain inactive for some time, not coming out of their burrows, and only gradually acquiring their normal colour and consistency."—(E. A. B.)

The possession of wings is an important item in the power of the beetles in distributing themselves harmfully to our furniture and woodwork; but when under observation, I found that they feigned death on being alarmed, and were usually sluggish in their habits, though occasionally temporarily brisk and moderately active.

The ticking noise, somewhat resembling the ticking of a watch, made at times by various of the *Anobium* beetles, and from which they take the name of Death-watch, is somewhat annoying, and used formerly to be the cause of a good deal of superstitious alarm relatively to its being considered to forbode a death of some member of the household. This noise, however, is not caused by the maggots, but by the beetles, and is considered to be merely a call to their mates given by strokes of the head, or mandibles on the wood, which, after a few repetitions, may be heard replied to, or even (it is recorded), if dexterously imitated, will attract appearance of beetles from the infested wood.

Anobium tessellatum (now *Xestobium tessellatum*) is distinguishable

* 'Our Household Insects,' by Edw. A. Butler, p. 7.

from *striatum* by being a good deal larger,—*striatum* ranging from about a line and a half to two lines in length, *tessellatum* from about two lines to three lines and a quarter. Also this stout little rusty or reddish-brown beetle is sprinkled on the thorax and wing-cases with patches of yellowish down, whence its name of being tessellated, and by this yellowish downy patching the species is clearly distinguishable from all the others of the twelve species formerly included in the genus *Anobium*, Fab., but now much altered in *generic* appellations. In out-of-door conditions this kind is noticed as being found in old trees, especially Willows; likewise it is mentioned by Taschenberg as occurring in woods, on parts of old stems from which the bark has been removed, most especially of Oaks; in rooms, or in houses, it is to be seen early in April at all the beams and rafters, as well as the boards in which the larvæ have bored. From the large size of this *Anobium*, it is very destructive to timber where allowed to work unchecked, and as far back as the time of Kirby and Spence the broadscale nature of its injury to the *whole* of the woodwork of houses was recorded.

The only observations of severe damage brought under my notice which were *attributed* to this species were sent me last December from Hartlepool. I was unable to procure specimens; but even should the devastation recorded not be the work of this kind, the record of such great damage where the attack of "Dust Beetles" has been allowed to take possession is of very practical interest. My correspondent asked whether there was any remedy for the ravages, adding:—

"The larva bores a small hole in the wood, generally of floors, and is a great pest here. I have seen floors so eaten away that what remained was much more like a sponge than anything else. At the present moment I am consulted with reference to the floors of a large warehouse. . . . The floor is formed of deals (Pine), three inches thick, laid on joists of the same wood, and these again on large iron girders. They are attacking the floor at present, and as to renew it would entail an expenditure of three or four thousand pounds, they are anxious to try some other remedy, if there be one."

Prevention and Remedies.—One great point is, as soon as ever it is noticed that attack is going on (which is easily observable by the dust dropped from the infested wood), to take the matter in hand without delay, *This is very important.* If nothing is done, the beetles will come out from the wood where they have developed and lay their eggs on it or any similarly suitable position at hand, and thus will continue constantly increasing destruction of property. Attention to this point is very greatly needed. So far as my own experience goes, the matter is commonly, or at least very often, allowed to run on year after year until the wood is so riddled by the workings that all strength is gone out of it, and expensive repairs or restorations are an absolute necessity.

It should be borne in mind that, in the words of Mr. E. A. Butler (see his work previously referred to, p. 6) regarding *A. striatum* (=*domesticum*) larvæ, "no wood is so old and dry that they cannot extract nourishment from it"; and I could name more than one cathedral where carving or relics of past days are allowed to fall a prey to the so-called "Dust Beetles" with as little care being bestowed to prevent antiquarian or artistic loss, as to prevent disaster to members of the congregation who may come to trouble from seating themselves over-hastily on a chair with an overly perforated leg!

In household affairs, the best way to ascertain whether mischief is going on is to turn up the lower side of chairs and tables, and examine whether perforations such as would be made with a very large pin are present. The dust falling from the borings would be a sure guide, but it may well be that in many cases this will have been swept away, and examination may be necessary to be absolutely certain of the state of the furniture. The little holes may be found in any other part of the furniture, as the legs or backs of chairs, fronts of picture-frames, &c.; but for the most part the portions which are most out of sight appear to be preferred for attack,—conjecturally because these are most exempt from the rubbings, dressings, polishings, and other housemaids' operations, *which rub off the "Dust Beetles'" eggs, or make the surface of the wood unsuitable for egg-deposit.*

If the egg is *detached* (so far as observations go), the larva cannot effect an entrance into the wood; also the mother beetle appears to exercise such care in choosing a suitable place for egg-deposit, that it is presumable that many kinds of applications to the wood to be protected would serve for deterrent purposes.

Good rubbing with beeswax and turpentine is a very good preventive if applied in late spring or early summer when the beetles are chiefly about.

Where more thorough measures are needed, a good application of turpentine, or of furniture oil, liberally applied to the perforated surfaces, so that it may be sure to soak into the little holes, and also may make the surface unsuitable for the egg to be fixed to, is an excellent treatment. Corrosive sublimate has been found to answer well (as, for instance, applied by soaking a choice carving which it was wished to save from attack in the fluid); but *this being poison*, it is not to be generally recommended.

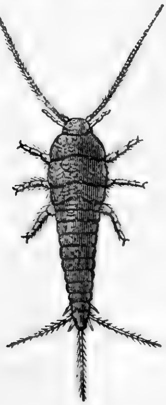
For general purposes, as for prevention or remedy of attack to beams, joists, or under floors in houses or farm buildings, probably tarring (early in the season, as above noted) would do all that is required to prevent egg-laying, and in farm buildings the smell of the tar would be no objection to its use. In house work a good coat or two of strong coarse paint would certainly stop the mischief to a great extent. Whitewash is sometimes recommended, but the other above-mentioned applications are much surer where circumstances allow of their use.

Good scrubbings with soft-soap wash with a little paraffin in it would be serviceable for floors, but it should be remembered that the special season for *preventive* treatment is late spring or early summer, when the beetles are *coming out and egg-laying*.

An application called "Duresco," which is stated to be a sort of washable water-colour free from objectionable smell, has been recommended for painting over the surface of floors on which goods were required to be laid (as in large stores); but I have not as yet had a report of the results from a locality where I understand the material is being experimented with on a large scale, and I am not myself acquainted with it.

But in remedial measures against the attacks of these wood-boring beetles, the great thing is to *take them in time*. To those unacquainted with the nature of the attack, a piece of infested wood often merely looks (until the evil has been long established) as if the beams or furniture were injured by more or fewer punctures, and for the most part in the case of inquiries addressed to myself, the mischief has passed the point in which there is much hope that it can be remedied.

"Silver Fish"; "Bristle-tails." *Lepisma saccharina*, Linn.
"Fire-brat." *Lepisma domestica*, Packard, = *Thermobia furnorum*, Rov.



Lepisma saccharina, magnified (after Sir John Lubbock).

The so-called "Silver Fish" are well known to housekeepers as narrow bright silvery little creatures, about a third of an inch long, which, when disturbed by light being thrown on them in any of their very various kinds of resorts, dash out of sight again into some concealed nook with a speed almost like the passing of a flash of light.

Though called "Silver Fish" from their bright silvery clothing of minute scales, they are not in any way related to fishes, neither are they insects. They belong to the division of *Thysanura*, which differ from insects in *not* going through a regular metamorphosis (that is, *not* through larval and pupal changes up to perfect development), and also they *never* acquire wings.

The *Lepisma saccharina* is about one-third of an inch in length, and silvery white in colour. The head is furnished with tapering horns about two-thirds of the length of the body, and the eyes are black; the mandibles (jaws) are strong and curved. The body, at the widest part, is about twice the width of the head, or a little more, and is thickest at the fore part, gradually tapering from the second segment behind the head to the tail.

Each of the three segments next to the head bears a pair of legs furnished with two clawed feet; at the tail extremity are three long bristle-shaped appendages, one pointing backwards, the two others pointing sideways at almost a right angle with the body. Propagation is by eggs.

The species was noted as long ago as 1665, in a small book published by the Royal Society, as injurious to books and papers, its general appearance being quaintly but not unaptly described as:—"Its head appears big and blunt, and its body tapers from it toward the tail, smaller and smaller, being shaped almost like a 'carret.'"

My own chief acquaintance with it was many years ago as inhabiting one or more of some deep flour-bins, holding perhaps a sack of flour apiece, in a dry warm room opening from the kitchen of a large country house; but as far as I remember, it rarely strayed to other parts of the house. Its most favourite food, as recorded, is starched clothing, linen, or curtains; also it is mentioned as sometimes doing very serious damage to silks, with the remark added that these "had probably been stiffened with sizing."

The chief cause of its depredations appears to be the attraction possessed by paste. It is mentioned that it is a serious pest "in libraries, particularly to the binding of books, and will frequently eat off the gold lettering to get at the paste beneath. . . . Heavily glazed paper seems very attractive to this insect, and it has frequently happened that the labels in museum collections have been disfigured or destroyed by it, the glazed surface having been entirely eaten off. . . . Its damage in houses, in addition to its injury to books, consists in causing the wall paper to scale off by its feeding on the starch paste." *

From their nocturnal, or at least darkness-loving habits, it is in dark or dusky places that these creatures are especially to be found, as under pots and the like places in larders, in dark wardrobes amongst the clothes, or in crannies of woodwork, or, again, on library shelves; and in German observation it is noted that in August the "Fishes" are to be found in their haunts of all sizes, pointing thus to summer time being the season of their multiplication.

The communications sent me, with specimens accompanying, from time to time have not added anything to the already known points of their history, and the means of prevention or remedy are suggested by their habits. These appear for the most part to turn on such measures as frequent moving of all vessels in larders amongst which the "Fishes" might shelter, shaking out clothes, well clearing out all crannies in wardrobes, and moving books on shelves, or laid where it is likely the creatures may have hidden themselves. In library prevention it is said that pyrethrum powder sprinkled on the shelves is of use; and where woodwork is not in order, it could not fail to be of service to fill up all chinks and crannies thoroughly. Where the infestation is to such an extent that wall-papers are loosened by the depredations, it would certainly be worth while to spread cloths or some material smeared with some tenacious substance at the bottom of the wall, and then taking the paper down piecemeal, and carefully, let the "Fishes" fall, and thus be captured. If after this the wall was repapered with some ingredient obnoxious to insect (or rather to "Silver Fish") life, mixed with the paste, and not hurtful to tenants of the room, the trouble might presumably be soon got rid of.

Until about six years ago, *L. saccharina* was considered to be the only species of the genus found in England; and in the 'Cambridge Natural History' (volume published in 1895, p. 186) is the observation:—"*Thermobia furnorum*, our other British Lepismid, has only recently been discovered; it is found in bakehouses at Cambridge and elsewhere. The bakers call these insects Fire-brats, apparently considering them to be fond of heat."

In the United States Bulletin published in 1896 (referred to in the note below) this species, given under the synonym of *Lepisma domestica*, Packard, is mentioned as having "become very common, particularly in the last year or two, in England and on the Continent." Of this it is said: "This species closely resembles the common 'Silver Fish' in size and general appearance, but may be readily distinguished from it

* 'Principal Household Insects of the United States,' p. 77. Bulletin No. 4. New Series. United States Department of Agriculture, Washington. 1896.

by the presence on the upper surface of dusky markings"; and a very good figure is given accompanying the description.

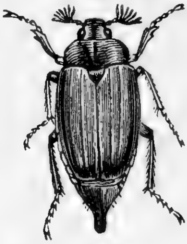
This species is stated to differ from our long-established kind in having a great love of hot localities. It is stated to frequent ovens and fireplaces, and seemingly to revel in an amount of heat which would be fatal to most other insects. "It disports itself in numbers about the openings of ranges and over the hot bricks and metal"; and it is mentioned that "the habit of this species of congregating in bakehouses and dwellings, about fireplaces and ovens, has given rise to the common appellation for it in England of 'Fire-brat.'" It is further mentioned that the creature possesses well-marked differences from the "Silver Fish," which have led to its late reference to a distinct genus—*Thermobia*. "An Italian entomologist, Rovelli, has described this insect under the descriptive name *furnorum*, from its inhabiting ovens, and the name of the genus to which it is now assigned by English entomologists is also descriptive of its heat-loving character."

The earliest description, that I am aware of, of this "bakehouse species" is that by Packard in 1873, under the appellation of *Lepisma domestica*, and with mention that it was common about fireplaces at Salem, Mass., U.S.A.

I have not myself seen specimens of this kind until last season, when in a consignment of "Silver Fish," part of the sample was so distinctly different from the rest in the matter of being much patched with grey on the back, that I think it must have been of this *L. domesticum* = *Thermobia furnorum*, but I had not the opportunity of identifying technically at the time, and therefore cannot be certain.

STRAWBERRY.

Cockchafer. *Melolontha vulgaris*, Fab.



Melolontha vulgaris.—Common Cockchafer, maggot, and pupa.

The attacks of Cockchafer grubs to roots of crops, whether of grass in pastures, to which they are exceedingly injurious, or of what may be more especially known as root crops, as Turnips and Mangolds, or Potatoes, up to mischief to the roots of young trees in nurseries, are only too well-known; but they are not often reported in this country as injurious to Strawberry plants. In the past season, however, I had just a few observations sent me (with specimens accompanying) of damage caused to a troublesome extent by the attack of these grubs to Strawberry plants in the early summer.

The first was sent me on May 28th regarding attack to a field of Strawberries of about two acres in extent planted in the previous autumn near St. Germans, Cornwall, and was a short note as follows:—

"I send herewith a specimen of a grub that is eating off my Strawberry plants just below the surface of the ground; it takes them clean off, just like a knife. What kind of grub is it? and is there any remedy?"—(J. P.)

On June 16th Mr. S. J. Wilde, writing from Elm Lodge, Englefield Green, Surrey, sent the following observations, with a sample (showing the damage to be caused by Cockchafer grubs) accompanying:—

"I lost a good many Strawberry plants last year, and am doing the same this year, by the grub of which I send you a sample. My gardener says it is the grub of the Cockchafer. I should be much obliged if you say the same, and also if you can tell me what to do to prevent the nuisance."

The above notes, it will be seen, only give two reports of attack of these special pests; but in one case the damage was considerable, as it extended over two acres of ground, cutting off the tops of the attacked plants as if with a knife; and in the other, the attack was a recurrence of mischief of the previous year. Little (if anything) has been reported in previous years of this kind o damage to Strawberry plants in this country, although on the Continent of Europe injury to Strawberry roots by Cockchafer grubs is amongst one of the regular attacks, and it is possible that by drawing attention to the matter it may be more fully observed and counteracted.

The Cockchafer beetle, figured at p. 120, must be too well-known to require description. Its reddish brown wing-cases make it a conspicuous object when at rest, and its powers of flight in the evening, when the large and powerful wings, folded beneath the wing-cases during the day, are brought into active service, and direct attention very thoroughly to the presence of the beetles.

To get rid of these, shaking them down during the day, when they are dull and sluggish, from the leafage on which they cling until the evening hours call them out in search of their mates, is the best remedial measure. To prevent their escape, hand-picking immediately; or shaking down on cloths, from which they may be directly swept up into vessels with some sticky stuff in them which will prevent the Chafers flying away; or having pigs at hand, which will eat the beetles greedily; or boys who, for a very small sum, will (with great pleasure) trample on the Chafers, and collect the bodies at some very small sum per quart: all are practicable measures.

The females lay their eggs in the ground at a depth variously stated as from two to four, or from about six to eight inches below the surface of the soil. These eggs, it is considered, hatch in about a fortnight, and the grubs, it is usually recorded, live (as they do in their older conditions) on roots of grass or other plants. It has, however, been *said* that in their first season after hatching the grubs do not feed on roots, but on *humus;* but whether this is so or not, I cannot myself say. They feed during the warm part of the season for three or more years, going down in winter to a greater or less depth according to circumstances; and at the end of the third or fourth summer go down to a depth *stated* to be two feet or more. Here they change to the perfect condition, the Cockchafers making their appearance early in the following summer.

The lowest depths by measurement from which Cockchafer grubs have been sent me were five to six inches below the surface. They had not been further down, because they were always found at the bottom of their burrow. This was at the beginning of the month of February.

Sometimes the grubs may be found present in great numbers in a given area. In the past year Mr. Thomas Forbes, of Swinton, Masham, Yorks, favoured me with a note of having in January observed great numbers of the larvæ of the Common Cockchafer when having pits dug [for tree planting]. The pits were made nine feet apart, and on an average nearly eight of the Cockchafer grubs were observed in every pit. This would show an amount of infestation present in the ground very capable of doing serious mischief to any roots suitable for grub ravage.

The grub, when full-grown, is of the shape and size figured at p. 120, whitish and fleshy, with the abdomen rather enlarged towards the extremity, and tinged with a bluish colour, consequently on the excrement showing through the skin. The yellowish horny head is furnished with strong jaws, and each of the three segments behind the head bears a pair of long reddish legs; the usual position is (as figured) lying on one side, and somewhat curved together. In the pupal state, also figured, it resembles the beetle, with the immature forming limbs folded beneath the body.

For prevention of attack, destroying the beetles when they appear in large numbers (as mentioned above) is of service, but destruction of the grubs when established in such places as Strawberry beds would be exceedingly difficult.

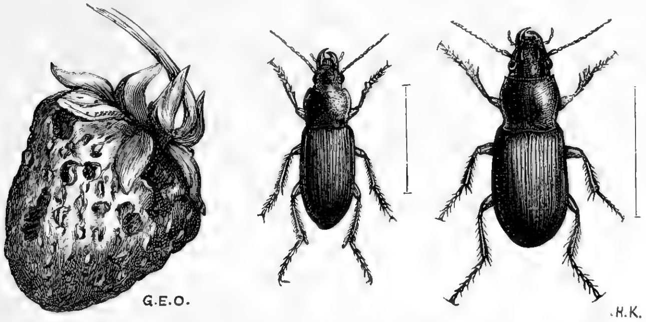
As a matter of precaution, where large areas of Strawberries are being planted (as mentioned at p. 120), it would be worth while for someone *personally interested in the matter* and also acquainted with the appearance of the grubs, to have some trial holes dug, about six inches deep, here and there in the ground which it is intended to plant, so as to ascertain whether the ground is clear of the infestation before trusting the plants to it.

Traps have sometimes been found to answer made of sods of grass. These, it is mentioned, were cut eight to ten inches broad, and six to eight inches thick, and laid (grass surface downwards) on the surface of the ground *in the autumn*, and during examination in July of the following year, the "turf-traps" afforded 16,000 grubs. The extent of area is not stated, but the diminution of amount of pests and broadscale proof of the plan being practically useful is worth notice.

It is neither likely nor to be desired that the expense of *preventive* measures should be gone to, unless there is good reason for believing grub infestation to be present; but this plan of "turf-traps" might be well worth trying as a *remedial* measure when Cockchafer or other Chafer grubs are found to be doing mischief. Also it might be well worth trying whether "traps" of less elaborate formation, such as pieces of slate, or tile, laid by the plants, might not serve sufficiently well for a shelter as to keep the grubs from burying themselves, and thus a daily search make clearance possible.

Wild birds, such as rooks and sea gulls, should on no account be driven off. The black-headed gull will follow the plough in the same manner as the rooks, and feeds on Cockchafers both in grub and beetle stages; and the beaks of these or other of the larger birds, which are adapted for piercing into the ground, will remove larvæ which lie within their reach without injury to surrounding rootlets, which would be caused by horticultural disturbance.

Ground Beetles—"Bat Beetle." *Harpalus ruficornis*, Fab.; *Pterostichus* (= *Omaseus*) *vulgaris*, Linn., and other species.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, and lines showing natural length. Strawberry fruit gnawed by *H. ruficornis.*

All Strawberry growers on a large scale will probably be only too well acquainted by report, even if they have not suffered under it themselves, with the very great damage now too often caused yearly by the large black or pitchy black beetles figured above (magnified) to Strawberry fruit just at the ripening or ripened stages.

The attack was first recorded as seriously destructive in 1894; since then it has greatly extended in area, and become (in the districts affected) a cause of great loss to Strawberry growers, and of annoyance, though on a less important scale, to private owners, whose plots were robbed by the beetles instead of affording fruit for household purposes.

The history of the attacks has been successively given in my Annual Reports for 1894, 1895, and 1897, with descriptions of the different species of "Ground Beetles" which caused the damage, and so much of their life-history as we are acquainted with. Also at pages 64–68, preceding, under the heading of "Mangolds—Ground Beetles," an account will be found of the attack of various of the same species as those that injure Strawberries to Mangold roots, with a figure of *Pterostichus* (=*Steropus*) *madidus*, a kind found especially present at the roots; and also figures showing the manner in which Mangolds were eaten off below the top of the root.

The beetles are for the most part about half an inch or rather more in length, although one species, *Calathus cisteloides* (not figured, but much like the others in shape), is smaller, being only from about a quarter to half an inch long. The colour is for the most part black, although, in the case of *Harpalus ruficornis*, it *appears* to be of a yellowish tint, from the wing-cases being covered, whilst the specimens are still fresh and uninjured, with a golden or greyish down. This kind also differs from the others noticed in being furnished with *ample wings*, usually folded away under the wing-cases, but which are sometimes freely used for flight of such large numbers of the species on summer evenings, that their numerous appearance is described as a "swarm." The other two of the larger kinds of beetles have the wings *entirely wanting;* in *C. cisteloides* the *wings are wanting*, or imperfect.

Full details of all information sent up to date will be found in my Annual Reports for 1894, 1895, and 1897; and a condensed account giving the chief points in my 'Handbook' of injurious fruit insects and remedial measures published in 1898. But amongst these it was only during the course of last year, and too late for insertion in my Annual Report for 1897, that we had information as to what is really the most important part of the whole matter practically; that is, observations of measures that could be trusted to for preventing beetle attack, or for checking it when present. Therefore I refer again to the infestation in order to insert these, of which the two first are especially valuable, as giving accounts, on excellent authority, of very successful use of easily carried out broadscale measures of trapping and destroying these fruit pests.

PREVENTION AND REMEDIES.—It was on July 19th in the past season that Messrs. Laxton (Brothers), of Bedford, were good enough to write me as follows, and, on my request, granted me permission to make use of the information with their name appended:—

"We are pleased to be able to report that we have almost entirely destroyed the beetle pest which played such havoc with our Strawberry crop last season. We purchased a large quantity of cheap pudding-basins, early this spring; these are let into the ground, level with the surface, at distances of a few yards apart, and kept them baited with pieces of lights and sugar-water. When the weather was dry we often caught half a basinful of a night, until the number gradually diminished to two or three, and now none at all. It is a laborious process, but well worth the trouble, as we have lost no fruit this season.—(Signed) Laxton Brothers."

The trouble and expense of this method of treatment is so very inconsiderable compared to the great losses where beetle ravage proceeds unchecked on the ripening fruit, that I strongly recommend it to the attention of all concerned, as well as the following simple and successful method of getting rid of the wasteful pests, for which I am indebted to the courtesy of Mr. Lewis Castle (Manager), Woburn Experimental Fruit Farm, Ridgmont, Aspley Guise, Bedfordshire. After mentioning in his letter of February 28th of the past year that a year or two since they had been greatly troubled with these Strawberry beetles, Mr. Castle observed:—

"I obtained a number of empty condensed milk-tins, placed about half an inch of tar in the bottom of these, and plunged them in the soil by the plants to the level of the rims. Enormous numbers were caught in this way, and for two seasons we have not been seriously troubled with them."—(L. C.)

Two special points in the habits of the beetles which it is desirable to bear in mind relatively to preventive measures are,—one, that *they are nocturnal* in their habits, and seek shelter during the daylight hours in cracks in the ground, or in the earth close to the attacked plant, even under the bunch of fruit which they have been ravaging, making their way down through the litter and straw placed round the plants. Another point is that these Strawberry feeders do *not lose their carnivorous propensities*, and may be attracted by meat.

Relatively to the first habit, another method which, if too expensive for broadscale growing, answered excellently on the smaller scale of a private garden, was mentioned to me by my friend and neighbour, the Rev. J. A. Cruickshank, as having answered thoroughly in saving his Strawberries in the Vicarage garden at Sandridge, near St. Albans, from *Harpalus ruficornis*, which had done much mischief there the previous year, and had again appeared. The ground amongst the Strawberries was covered, as is customary, with straw, and the plan adopted by the gardener was to remove the straw from a space, and then, trowel in hand, turn over the surface of the ground temporarily laid bare, and secure the sheltering beetles. Thus, gradually going in this way through the bed, the beetles were captured by hundreds, and whereas the first part of the crop was ruined, afterwards (when the plan was carried out) the fruit was saved from further ravage.

Relatively to utilizing the carnivorous habits of the beetles, it has been reported that "flesh covered by pieces of thick sacking attracts a number, which are easily killed." It will be observed that in Messrs. Laxton's method of trapping the basins were partially baited with pieces of "lights." Conjecturally speaking, I should suppose any kind of spare waste meat would answer equally well, for in my own *indoors* observations, I found that *Harpalus ruficornis* and *Pterostichus vulgaris* would feed willingly (as a variety on Strawberry ravage) on live worms, uncooked mutton, cooked meat and fish, and bread. Probably the meat or fish would be the most attractive by reason of the stronger and more widely diffused smell.

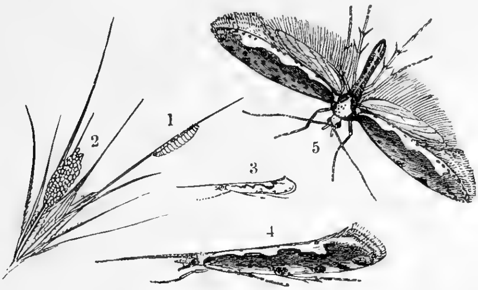
At present we need for completion of the life-history of the beetles some observations of method of life of their grubs, of which, so far as I am aware, we have no descriptions, but which may be presumed to resemble others of the *Geodephaga*, that is, the Ground Beetles, in their appearance and habits. These are stated to be mostly found in the same places as the perfect beetles. In shape "they are usually flat, elongate, parallel-sided, fleshy, with the head and first segment hard; . . . the legs are horny, six in number, and situated on the first three segments; there are short jointed antennæ and palpi, and powerful *sickle-shaped* jaws, and the apex of the body has usually two horny or fleshy appendages on its upper surface, the lower part being lengthened into a membranous supplemental leg." *

In the case of the three kinds of Ground Beetles which are wingless, it appears certain that the grubs (or *larvæ*) must either feed in the ground near the plants, or be brought there in soil or enrichments, and it is possible that if we knew whereabouts in the earth the grubs are to be found, and how deep they lie for their pupal changes, we might be able to bring some preventive measures to bear on them also.

* 'British Beetles,' by E. C. Rye, pp. 44 and 46.

TURNIP.

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



PLUTELLA CRUCIFERARUM.—1, caterpillar; 2, eggs; 3–5, Diamond-back Moth, natural size and magnified.

Since the memorable appearance of Diamond-back Moth caterpillars in 1891, and a lesser, although injurious, appearance in the following year, the infestation has not appeared in sufficient numbers (excepting a moderate amount of presence in 1894) as to call for a special report, and in one only of the intermediate years (1896) up to present notice, has inquiry been sent to a sufficient amount even to allow of its name standing in the list of insects noticed during each year. In the course of the past season (1898), however, I have received some small amount of observation of the infestation from one North British locality, which is of practical interest as once again referring to attention being drawn to the presence of the moth caterpillar on Turnip leafage, by the concourse of sea gulls busy amongst what, on investigation, proved to be infested crop.

On July 7th of the past season Mr. W. D. Anderson, writing from Ardsheal, Ballachulish, Argyleshire, N.B., kindly sent me the following note:—

"Again, I regret to say, the Diamond-back Moth is attacking our Turnips. As in previous years, the presence of a flock of sea gulls on the crop led me to inspect it closely. The leaves showed the markings and holes characteristic of the ravages of this pest, but I searched for some ten minutes before I came on the caterpillar herewith enclosed. I think it has begun to spin. . . . Whilst writing this letter, the caterpillar has moved out of what appeared to me the beginning of a cocoon."—(W. D. A.)

The specimen sent was certainly a caterpillar of the Diamond-back Moth (*Plutella cruciferarum*). These are only about half an inch long at full growth, and tapering slightly to each extremity. The colour is variable, usually of a delicate or apple green ; but in younger state the caterpillars are often yellowish or greyish, with black head. When near full growth the head is usually grey or yellowish, and marked with small black dots ; the next segment is remarkable for the *absence* of the two dark patches often found in the case of small caterpillars of allied kinds, and instead has a number of very minute black specks. The rest of the segments have a few black dots. Each of the first three segments bears a pair of claw-feet, and there are also four pairs of sucker-feet beneath the body, and another pair (which are very noticeable from being set out somewhat obliquely) at the extremity of the tail.

When full-fed, which may be in about four weeks, the caterpillars spin their cocoons for the most part at their customary feeding-place, the *under side* of the leafage of their food-plants, or on stems, &c., near. These cocoons are sometimes a mere open net-work of white threads, through which the colouring of the chrysalis can be distinctly seen ; and, so far as I can judge from the many specimens which passed through my hands in 1891 (the year of the great attack), there is a good deal of variety in this matter. The characteristic colour when mature is whitish with some black streaks ; in the early part of their formation the chrysalids may be green or brownish, and sometimes the cocoons, instead of being a mere open net-work of white threads, are thicker, and of a somewhat boat-shaped form.

The moths may come out in from about one to three weeks from commencement of the chrysalis state, and are of the size given at "3," p. 127. The front wings are long and narrow, greyish brown along the centre, and fore edge, with some small brown spots in front ; a rather broad whitish or ochreous grey band runs along the hinder margin, so shaped along its fore edge that when the moth is at rest, with the wings laid along the back and their edges meeting, the pale patterns form a row of diamond-shaped markings, whence the name of Diamond-back Moth (see figures 4 and 5, magnified, p. 127).

There may certainly be two broods during summer or autumn, and the chrysalids from the latest brood of the year remain in this state through the winter.

Returning to the special point of sea gulls, and also of the kinds of sea gulls noticed on infested land, it was in 1894 that Mr. W. D. Anderson, whose note I give at p. 127, preceding, favoured me with the following observation regarding their presence at the same locality, namely, Ardsheal, Ballachulish, Argyleshire, N.B., during the month of August. Mr. Anderson remarked :—

"My attention was first drawn to the field where the caterpillar was discovered by a large flock of gulls (herring gull, common gull, and kittiwake) that had settled on *one-half of it*, and seemed to remain there day and night. I never actually detected them eating anything; on the contrary, they seemed to be wandering about in rather an aimless way."—(W. D. A.)

On examining the condition of the crop, however, Mr. Anderson found that the Diamond-back Moth caterpillar was very plentiful on the half of the field occupied by the gulls; whilst he was only able to find one or two specimens on the portion of the field which was neglected by the birds. Also it was mentioned that about eight miles south of the locality there was a similar occurrence with a blighted crop, the farmer attributing the destruction of his Turnips to the ravages of the gulls.

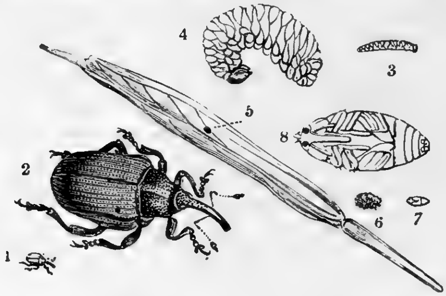
In the case of this infestation, birds of several kinds play such a very useful part as remedial agents, that, as it is possible I may not have such an appropriate occasion again of drawing attention to it, I refer now specially to the matter, and to the great importance when flocks appear in large numbers of (not only) *not* driving them away, but also of instituting careful search beneath the Turnip leaves to see whether infestation is present and needs looking after.

Besides the sea gulls, which were also noted from Lancashire as frequenting some Diamond-back-infested land in great numbers, and also doing service at a locality in Northumberland, starlings have been especially noticed as useful. This bird is more repeatedly reported as a helper against the caterpillars than any other kind, the notes constantly recurring that,—starlings frequented the infested land; starlings in flocks were noted feeding; many starlings when we had the caterpillars; starlings are especially useful in clearing the caterpillars; starlings present in thousands; and also that starlings had done much good.

Other birds were also mentioned as doing good, and amongst them the Lapwing, or Peewit (*Vanellus cristatus*); but in the great attack of the Diamond-back Moth in 1891, which (besides other localities) was present in the counties along our eastern seaboard from Dover in Kent to Aberdeenshire in North Britain, the replies to the question sent out in my official circular of various inquiries as Entomologist of the Royal Agricultural Society regarding what kind of birds helped in the great trouble, specified the starling as by far the most serviceable.

Details of the attack, with some means of prevention and remedy, and much other information, will be found in my Annual Report for 1891, pp. 105–164.

Turnip-seed Weevil. *Ceutorhynchus assimilis*, Payk.
Turnip and Cabbage Gnat Midge. *Cecidomyia brassicæ*, Winn.



Ceutorhynchus assimilis.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa (all natural size and magnified); 5, infested Turnip pod.

The causes of loss to Turnip-seed growers from attacks to seed, accompanied by distorted growth and premature yellowing and cracking open of the pods, have for many years been the subject of inquiry. The damage is referable to two quite distinct kinds of infestation, one being that of the Turnip-seed Weevil, figured above; the other of the Turnip and Cabbage Gnat Midge, *Cecidomyia brassicæ*.

The Seed Weevil has been repeatedly mentioned before, especially in 1891, but is just referred to again in order to point out the differences between it and the "Gnat Midge," and their respective methods of attack to the seed. The little beetle is not quite the sixth of an inch in length, including its (comparatively) long and curved proboscis. When freshly developed, it appears to be grey, owing to the coating of grey or whitish hairs with which it is covered; but when these are rubbed off, it is black. There are two broods in the year, of which the second lives through the winter, and the beetles, which have great power of dispersing themselves, from the ample size of their wings, feed on flowering shoots of Turnip, Rape, Mustard, or allied plants. The maggots feed on the seed within the pods, and by a little careful watching may be seen in the act of preying on the seed with their little brown jaws, and the seed in various stages of consumption, from a small piece having been eaten to the whole of the seed being cleared out of the skin by the maggot still within, and wet green rejectamenta, the result of feeding, lying at the caudal extremity of the maggot shows that the devouring of the seed is then going on.

This method of feeding, that is, the *consumption of the substance of the seed*, is an easy way of distinguishing the attacks of the weevil maggots from those of the maggots of the Gnat Midge, which do *not eat up* the seed, but destroy it by *suction*, so as to cause the seeds to shrink and sink in.

The weevil maggots are distinguishable by being (as figured at p. 130, magnified) fleshy and legless, transversely wrinkled, yellowish white in colour, with brown or pale brown heads, and when full-grown, only about half an inch long. When full-grown, and consequently on the premature opening of the seed-pods, they fall to the ground, and bury themselves for their change to pupa or chrysalis (see figure, p. 130). This is of a dull ochreous colour, with black eyes; the pupal state continues for about three or four weeks in the summer.

The above notes are only given for convenience of comparison with that of the Gnat Midge without the trouble of special reference; some detailed notes will be found on the attack, together with that of the Turnip-flower Beetle, *Meligethes æneus*, in my Annual Report for 1891, accompanied by observations of some moderately successful methods of prevention of damage, and in 1897 I again mentioned it, together with the attacks of the Gnat Midge.

On July 20th in the past season Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, N.B., who had communicated with me regarding presence of this Turnip-seed pest in the two preceding years, wrote me again as follows:—"The larvæ of the Turnip-seed Midge are again very destructive with us. I will write you again" (W. S.). On August 9th Mr. Sim continued:—"My crop of Yellow Turnip seed is almost a complete loss. Last year the damage done was very extensive and disappointing, so I had the roots planted last autumn in another field. The strong healthy foliage and rich blossom in the spring showed every indication of a full crop, but the seed-pods were scarcely formed when they began to turn yellow by the attack of myriads of the midge maggots. Now, when the crop is cut, the damage can be ascertained, and I must be content with stones of small worthless seed in place of hundredweights. The disease made its first appearance on the 1st of July, and some of the larvæ were full-fed and began to escape three days afterwards. A few handfuls of the infested seed-pods put in sterilized earth, and covered over began to give birth to the midge about the middle of July, and by the end of the third week they were issuing forth almost in clouds every time the covering was removed. This destructive pest is likely to be overlooked, and other causes attributed to the loss and failure of the crop, as only those that are giving the subject their close attention could believe and estimate the amount of damage. Swedes have seeded well, and, though not absolutely clear of the midge maggot, are a good average crop. The Turnip-seed Weevil has given little trouble this year."—(W. S.)

The larvæ, or maggots, of the Gnat Midge (that is, of the *Cecidomyia brassicæ* of Winnertz, which these appear to be) are easily distinguishable from those of the Seed Weevils by the heads being so very small as not to be observable without strong magnifiers, nor armed with strong mandibles. The shape is somewhat oval or parallel-sided, lessening to the head and tail end. The length three-quarters of a line or slightly more; colour milk-white with a yellow food-canal; the surface has the appearance of being granulated, and the hinder edge of the *penultimate* ring is edged with bristly hairs.

The anchor process—that is, the small somewhat anchor-like organ present in *Cecidomyia* larvæ, placed beneath the body near the head end—was unusually difficult to find; but on long investigation I found the stem (by the end of which it is attached to the larva) was parallel-sided for about three-fifths of its length, and then swelled out, the free extremity being about twice the width of the stem, flattened at the end, and *slightly* notched.

These maggots (it is noted by Dr. J. Ritzema Bos) "are to be found in the last half of May and in June in Rape-pods, and may be found in great numbers even up to forty or fifty in one pod, where they suck the unripe seeds to such an extent as to destroy them before the time of ripening. The pods swell at the maggot-infested spots, and ripen and wither also earlier than those which are uninfested, and burst open, and the larvæ fall to the ground, where they change to pupal state. In about ten days a swarm of little Gnat Midges make their appearance, and these again lay eggs in the pods, which are to be found at the upper part of the stalks of Rape or other cruciferous plants." *

The perfect insect or Gnat Midge of *Cecidomyia brassicæ* is gnat-like in shape, but very small, rather less than the twelfth of an inch in length, with head and back of thorax dark or black with silvery hair; the abdomen flesh-coloured, usually with brown or black bands. Legs black, silver white beneath, turning lighter after death. Wings transparent flesh-colour at the base, very brightly iridescent; the fore edge black, as also the veins; and the first long vein very near the edge.†

This species turns black after death, and though it appeared to me that the specimens sent me might be presumed to be of this species, I could not be absolutely certain; still, judging also from the similarity of the larvæ, and the habits, including some of the additional points in these reported as above by Mr. Sim in his observations of the past season, it seems to be scarcely open to doubt that it is *Cecidomyia brassicæ*, Winnertz.

Prevention and Remedies.—As yet we do not seem to have knowledge of any practicable preventive or remedial measures, but yet there

* 'Tierische Schädlinge und Nützlinge,' von J. Ritzema Bos, p. 588.

† For full description of perfect insect see 'Fauna Austriaca: Die Fliegen (Diptera),' Schiner, vol. ii. p. 374; and also 'Praktische Insektenkunde,' Taschenberg, pt. iv. p. 8.

are some that might be worth trying. The larvæ are very small and tender, and as in the case of the very nearly-allied Cecid of the Pear, *Diplosis pyrivora*, dressings of kainite sprinkled on ground where the larvæ have gone down have been found to act extremely well in destroying a very large proportion of the grubs before their change to the pupal state, there does not seem to be any reason why a dressing applied when the maggots are leaving the pods might not answer equally well in checking the Turnip as the Pear-blossom Gnat Midge.*

It should also be noticed that there is a *second brood* of Gnat Midges, which breed in the pods at the end of the shoots. It may certainly be considered that the first infestation of each year arises from the *C. brassicæ* which have wintered from the last brood of the preceding season, probably in larval or pupal condition.

This point is what we need especially to lay our hands on for preventive treatment. Cutting off and destroying these small ends of shoots with the small pods would pay well by checking coming infestation if attack was found present. Also, from careful observation, such as that of Mr. Sim, we might learn in what state the pests pass the winter, and thus know with certainty whether they could be dealt with by dressings or other agricultural treatment in the ground to which the larvæ dropped from the pods.

* Reference to this application will be found under the head of Pear Gnat Midge, p. 91, preceding, with mention also of other dressings effective in preventing development of larvæ.

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Horace Knight ad nat. del. West Newman lith

Foot of Forest Fly (Hippobosca equina *Linn.*)

Seen from above greatly magnified.

Horace Knight, ad nat. delt. West, Newman lith.

Foot of Grouse Fly. (*Ornithomyia avicularia, L.*)
(Greatly magnified.)

OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS

DURING THE YEAR

1899

WITH METHODS OF

PREVENTION AND REMEDY.

BY

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54, HATTON GARDEN, E.C.

PREFACE.

During the past season reports of observation of a great variety of insect infestations were forwarded, many of these being of our ordinary farm and orchard pests, but some also which had been little previously noticed, and of others details of habits, or of preventive measures, were contributed, serviceable for completing previous notices. The only crop attack, however, which was mentioned as seriously prevalent was that of Turnip Flea-beetle. The caterpillars of Cabbage Butterflies (as in the previous season) did a good deal of damage locally; and for about six to eight weeks from May 20th much application was sent for leaflets on Wireworm, sometimes amounting to five or six applications daily.

Some infestations which are often seriously injurious were little reported—as Surface Caterpillars to root crops; and Mangold-leaf Fly maggots; orchard caterpillars (including amongst them those of the Winter Moth) were little noticed; the caterpillars of the Gooseberry and Currant Moth and Sawfly were also little mentioned.

Amongst field crop attacks, some addition to previous information was noted in regard to different kinds of "Pear-shaped Weevils" at Clover seed-heads. Amongst Corn attacks, some of the well-known kinds—as those of the maggots of Oat Frit Fly, Wheat-bulb Fly, and Corn Sawfly within Wheat stems—were just enough reported to show they were not absent, as also Hessian Fly in Wheat in one locality, and I would most particularly desire to draw the attention of agriculturists (in case of this infestation occurring again in the country) to the notes given at p. 39, on the importance of *destroying* infested screenings with the contained chrysalids, the so-called "Flax-seeds." With regard to insect infestation in flour, whether as a generally spread home trouble in mills, &c., or in imports, the communications were on a much larger and graver scale than in any preceding year, and I have especially drawn attention to details connected with the "Mediterranean Mill Moth" in a paper under that heading, pp. 76–92. Amongst Hop observations a good working observation was given of possibility of broadscale trapping of the Click Beetles (the parents of the Wireworms); also notes of Hop Flea Beetle on the leafage, helped to give some additions needed to connect this attack in summer with that of the maggots later on in the Hop cones. Very little was mentioned about Mangold injury, and no new information contributed about attacks on these or Turnip crops.

Amongst Fruit attacks some notes were sent of mischief caused by the very small caterpillars of the Eye-spotted Bud Moth feeding at the end of Apple shoots amongst the bunches of opening leaves, and blossoms,—an attack which has only recently been noticed, and on which more observations are needed. On Currant leafage the caterpillars of the so-called Spinach Moth have not been previously reported, and some observations are given on *non-transportation* of the Black Currant Gall Mite in earth at roots of removed bushes.

The Pear Gnat Midge attack to very young Pears, which was first noticed as seriously prevalent in 1898, was very little reported, and on special enquiry in 1899, at the localities of infestation, had been checked very satisfactorily where the requisite treatment had been applied. The Raspberry Moth and Strawberry Ground Beetles also it is found can be kept thoroughly in check by the remedial measures noted.

Diptera (two-winged flies, and more especially animal flies) were more than usually enquired about; and of the two kinds mentioned which are not known as doing much harm with us, the rare Red-bearded Throat Bot Fly of the Deer is mentioned as giving another record of presence, and at the great altitude of three thousand feet; and the Grouse Fly as giving a little more record of its pupal stage, and opportunity for securing a figure (see frontispiece) of the elaborate structure of its foot. The Cheese and Bacon Fly is a severe trade trouble, which I am obliged by practical assistance in bringing forward.

The following list gives the names of the most important of the British infestations regarding which enquiries have been sent, mostly with specimens accompanying.

Beetles (*Coleoptera*).

Ash-bark Beetle ("Greater Black"), *Hylesinus crenatus*	In Ash trees.
Cadelle, *Tenebrioides* (*Trogosita*) *mauritanicus* . . .	Stored grain and insects.
Cockchafer, *Melolontha vulgaris*	Leafage and crop roots.
Death-watch Beetle, *Anobium paniceum*	Seeds, stores, &c.
Flea Beetle (Hop), *Psylliodes attenuata*	Hop plants and cones.
,, (Turnip), *Phyllotreta* (various species) . .	Turnip leaves.
Flour Beetle (Confused), *Tribolium confusum*	Stored flour.
,, (Rust-red), ,, *ferrugineum* . . .	,,
Ground Beetle, *Harpalus ruficornis*	Strawberry fruit.
Mustard Beetle, *Phædon betulæ*	Mustard.
Turnip Flower Beetle, *Meligethes æneus*	Turnip flowering shoots.
Weevils, Black Vine, *Otiorhynchus sulcatus*	Vine leaves, roots, &c.
,, Clover Black-footed, *Apion nigritarse* . . .	Chiefly in Clover heads.
,, Clover-head, *Apion trifolii*	,, ,,
,, Clover Purple, *Apion apricans*	,, ,,
,, Downy Brown, *Phyllobius oblongus*	Orchard leafage.
,, Granary, *Calandra* (=*Sitophilus*) *granaria* .	Stored grain.
,, Pea and Clover-leaf, *Sitones* (various species) .	Leafage.
Willow (Mottled) Beetle, *Cryptorhynchus lapathi* . . .	In Alder and Willow.
Wireworms, larvæ of *Agriotes obscurus*	Roots of crops of many kinds.
,, ,, ,, *sputator*	,, ,,
,, ,, *Athous rhombeus*	Sometimes carnivorous.

Butterflies and Moths (*Lepidoptera*).

Buff-tip Moth, *Pygæra bucephala*	Leaves.
Cabbage White Butterflies, Large, *Pieris brassicæ*	Cabbage leaves.
,, ,, ,, Small, *Pieris rapæ*	,,
,, ,, ,, Green-veined, *Pieris napi*	,,
Common Vapourer Moth, *Orgyia antiqua*	Fruit-tree leafage.
Currant ("Spinach") Moth, *Cidaria dotata*	Currant leaves.
Death's-head Moth, *Acherontia atropos*	Potato leaves.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Eyed Hawk Moth, *Smerinthus ocellatus*	Apple leaves.
Eye-spotted Bud Moth, *Tmetocera ocellana*	Apple buds and leaves.
Lobster Moth, *Stauropus fagi*	Leaves of Oak, &c.
Mediterranean Mill Moth, *Ephestia kuhniella*	Stored flour.
Privet Moth, *Sphinx ligustri*	Privet leaves.
Puss Moth, *Dicranura vinula*	Poplar and Willow leaves.
Raspberry-bud Moth, *Lampronia rubiella*	Raspberry flowers & leaf-buds.
Surface Caterpillars (*Agrotis* of various species)	Roots of Turnips, corn, &c.
Wood Leopard Moth, *Zeuzera æsculi*	Wood of Pear branches, &c.

Two-winged Flies (*Diptera*).

Cabbage-root Maggots, *Anthomyia* sp.	Cabbage roots.
Cheese and Bacon Fly, *Piophila casei*	Cheese and Bacon.
Daddy Longlegs (Cabbage), *Tipula oleracea*	Roots of Grass, Strawberry, &c.
,, (Spotted), ,, *maculosa*	,, ,,
Deer Forest Fly, *Lipoptera cervi*	On Deer.
Deer Throat Bot Fly, *Cephenomyia rufibarbis*	Nostrils & throat of Deer.
Frit Fly, *Oscinis frit*	Young Oat plants.
Grouse Fly, *Ornithomyia avicularia*	On Grouse.
Hessian Fly, *Cecidomyia destructor*	Barley and Wheat stems.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Ox Warble Fly, *Hypoderma bovis*	In hides of cattle.
Pear Gnat Midge, *Diplosis pyrivora*	Young Pears.
Sheep's Nostril Fly, *Œstrus ovis*	Sheep's nostrils.
Wheat-bulb Fly, *Hylemia coarctata*	Young Wheat plants.

Sawflies, &c. (*Hymenoptera*).

Corn Sawfly, *Cephus pygmæus*	Inside Wheat stems.
Sirex, Giant, *Sirex gigas*	Pine timber.
,, Steel-blue, *Sirex juvencus*	,,
Slug-worm of Pear Sawfly, *Eriocampa limacina*	Pear and Cherry leaves.

Crickets, Cockroaches (*Orthoptera*).

House Cricket, *Acheta domestica*	General feeders in houses.
Cockroach, German, *Phyllodromia germanica*	,, ,,

Aphides, Scale Insects, &c. (*Homoptera*).

Aphis, Woolly Apple, "American Blight," *Schizoneura lanigera*	Apple bark.
Scale, Apple, Oyster Scale, *Mytilaspis pomorum*	Bark.
,, Beech "Felt," *Cryptococcus fagi*	Beech bark.
,, Currant and Gooseberry, *Lecanium ribis*	Bark.

The above list gives names of the most important of the attacks regarding which communication has been made. There has been also enquiry regarding attacks of crop pests commonly known as insect allies, as Julus-worms, or False Wireworms, Eelworms, &c.; and of two of these attacks, entered on in detail, that of the Snail-slug is given on account of it being so *beneficial*, by preying on earth vermin, that it is desirable that it should not be destroyed as an ordinary Slug; and the "Planarian," or

"Flatworm," as, from its repulsive snake-like appearance, it may save a little uneasiness for it to be known that any small harm it may do is to plants only.

An unusually small amount of enquiry was sent with regard to timber-infesting insects, excepting the Pine-injuring Giant Sirex, which, from its great size and bright yellow markings, attracts much attention.

Extra-British communication has been greater than usual, including more especially enquiries as to attacks from Cape Town, also at Siam, in Ceylon, at Las Palmas (Canary Islands), Helsingfors (Finland); and investigation as to presence of various kinds of flour-infesting insects in imports from various countries.

The different arrangement commenced in this first number of my Second Series of giving a division of "Short Notices" (see p. 137), following the special Insect reports, has been adopted in order to utilize contributions of observations which may possibly *lead on* to more complete information on special attacks, or are serviceable as making *previous observations more complete*, without unnecessary repetitions regarding histories and habits.

Information given in the twenty-two preceding Reports is made easily attainable by the excellent Index,* prepared by Mr. R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, in which fully detailed reference is given, including the scientific and popular names of the insects, with coincident points of serviceable interest—as dates of first or of great appearances, remedial applications, &c.; and likewise a Plant Index is added, with references to insect infestations, arranged under the heading of each kind of crop or fruit plant attacked; and an Animal Index is also given.

The amount of enquiry during the past season has been as much, or more, than in previous years; but there is great satisfaction in it being obvious that serviceable *practical* knowledge of how to deal with our ordinary crop and fruit pests (as well as application of information) has been taking such good root in the country as must be saving much agricultural loss.

With the help of my secretary, Miss Hartwell, I am able to attend to all applications sent, with only a little delay when they are more than usually numerous. Should entomological aid be necessary, I have arranged, as I mentioned previously, to ask the co-operation of Mr. R. Newstead; but in this case *I should not fail to acknowledge the assistance.* In my present number I am indebted to him for compilation of the Index, and for contribution of a valuable observation on Pear Sawfly, also on Black Currant *Phytoptus;* but these, as well as the information from *all* my other kind contributors, are duly acknowledged in connection with the information given.

My thanks are gratefully offered to many kind co-operators, not only for special help by letter, but also the assistance from

* See 'General Index,' advertised on wrapper.

the only too liberal donations of entomological works with which I am constantly favoured by presentation of Colonial and Continental publications, and likewise from the United States of America, including the admirable publications of their Department of Agriculture, embodying both practical and scientific information, the value of which cannot be too widely appreciated.

In regard to the illustrations in this number, those at pp. 1, 3, 20, 26, and 64 are given by kind permission of Messrs. Blackie & Son, Glasgow, N.B.; that at p. 46 is from Newman's 'British Moths'; that at p. 101 from the 'Gardeners' Chronicle'; the *Phytoptus* at p. 40 is by permission of Dr. Nalepa; and the *Ephestia kuhniella* at p. 76 is from Farmer's Bulletin No. 45, U.S.A. Department of Agriculture, Washington; the others have been almost entirely figured from life for this series of Reports.

In the coming season I shall hope to give my best attention in careful reply to all enquiries which may be sent to me, and I offer my sincere thanks to all my co-operators through whose help I have been able, through the long series of twenty-three years, to lay the trustworthy observations of practical agriculturists and observers of farm and orchard pests before the public.

ELEANOR A. ORMEROD, F.E.S.

TORRINGTON HOUSE, ST. ALBANS:
March, 1900.

List of Injurious Insects, &c., noticed in this Report.

SHORT NOTICES.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

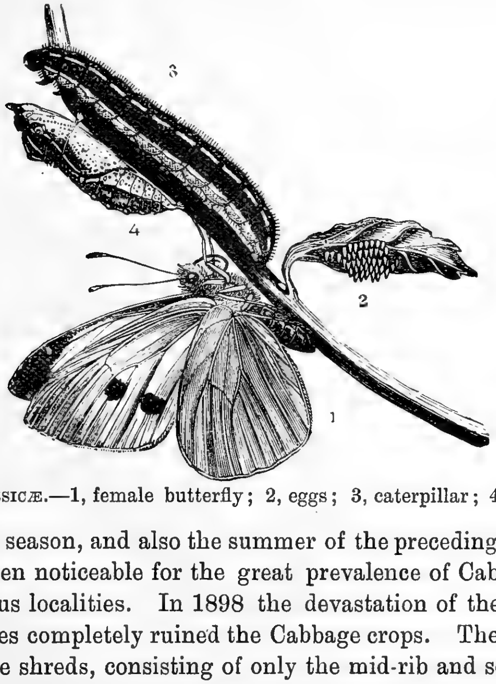
COMMON CROP PESTS

DURING

1899.

CABBAGE.

CABBAGE BUTTERFLIES — **Large White**, *Pieris brassicæ*, Linn. **Small White**, *Pieris rapæ*, Linn. **Green-veined White**, *Pieris napi*, Linn.



Pieris brassicæ.—1, female butterfly; 2, eggs; 3, caterpillar; 4, chrysalis.

The past season, and also the summer of the preceding year (1898), have both been noticeable for the great prevalence of Cabbage butterflies in various localities. In 1898 the devastation of the caterpillars in some places completely ruined the Cabbage crops. The leaves were eaten to mere shreds, consisting of only the mid-rib and some amount of side veins; and even if the plants were not killed, such growth as the remnants of life left in them enabled them to make was delayed till so late in the year that it was too weak to be of much service, and the result was great loss to market gardeners, and much inconvenience to householders from non-supply of such a convenient vegetable in its usual plenty and luxuriance.

In the past season, although severe in some localities, I am not aware of the mischief having been as great as in 1898; and though the infestation has been very frequently referred to in previous Annual Reports, it seems worth while to allude to it again, as some few additional points bearing on preventive measures can be added, and some also of description of the early stages.

All of our Brassicaceous crops which afford convenient feeding-ground on tender leafage at the time that the butterflies are about—as, for instance, Broccoli and Cauliflower, and the spreading leaves of Brussel Sprout plants before the rosettes are developed—are liable to attack, as well as the kinds especially known as "Cabbage"; Turnip leafage may also be attacked, and there is record of the Hearted Cabbage being attacked in the same manner as by the caterpillars of the Cabbage Moth.

The butterflies are so well known that it is not necessary to give a detailed description, more especially as there do not appear to be any other kinds of white butterflies which occur similarly in flocks on Cabbage crops in this country.

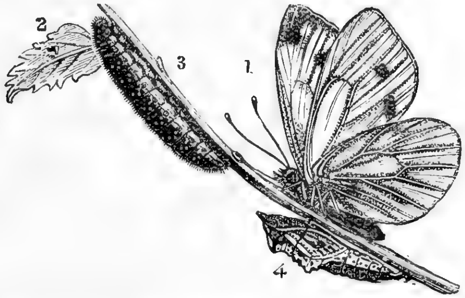
There are three kinds of these Cabbage butterflies—the "Large White" (*Pieris brassicæ*), the "Small White" (*Pieris rapæ*), and the "Green-veined White" (*Pieris napi*); all of these three kinds are white, more or less marked with one or two spots, and tipped with black or grey, on the wings, and all of them were formerly said to lay their eggs on the under surface of the attacked leafage; but more recent observations have shown that the eggs of *P. brassicæ* may be laid on either side of the leaf.

Of the above-named kinds *P. brassicæ*, figured at p. 1, is the largest; and the caterpillars are distinguishable by their large size, and by being greenish or bluish in colour above, and yellow below, with a yellow line along the back, and another showing more or less clearly along each side, and also by being very observably spotted, or blotched, or almost striped with black along the upper part; also they have tufts or a sprinkling of hairs. The chrysalids, which are suspended to some support by a silken thread passed round them (see figure, p. 1), as well as those of the other two kinds named, are of various shades of green with some yellow markings and black dots and spots. The eggs are somewhat flask-shaped, laid in clusters at times on the upper * as well as the under surface of the leaf, and affixed by one end.

* See 'Larvæ of British Butterflies and Moths,' vol. i. "Butterflies," p. 150, by (the late) William Buckler. Ray Society.

The Small White is about two-thirds of the size of the Large White in expanse of the fore wings, this being about two inches, and the Large White from two and a half to three inches. The caterpillars are velvety when full grown, green or dull green, much paler below, with a yellow line along the back, and a faint yellow line with a row of yellow spots along each side. The chrysalids are variable in colour; pale flesh brown, dusky drab, or greenish, are some of the colours named; some with a freckling of black, some finely powdered over the back with black, and some with "a rosy pink" or dull green tinge suffused all over them. The eggs are laid singly, and (so far as yet recorded) beneath the leaves; the colour "very pale greenish yellow," gradually becoming of a more decided yellow; the shape and also attachment by one end the same as those of the eggs of *P. brassicæ*, the Large White.

The Green-veined White Butterflies are so called from having broad greenish margins to the veins of the lower side of the hind



Pieris napi, Green-veined White Butterfly.—1, female; 2, egg; 3, caterpillar; 4, chrysalis.

wings, which are otherwise of a sulphur or pale yellow, and may thus be distinguished from the Large White, of which the under sides of the hind wings are of a dull palish yellow speckled with black, and those of the Small White, which are similarly yellow on the under side, but thickly speckled with black towards the base. The caterpillars when full-grown are velvety, or in more detailed description "the whole skin, including the head, set with sharp points, all furnished with short hairs; the colour a full green," somewhat of a paler greyer green below; a darker green line along the back, and an indistinct yellowish green line along each side, on which are black spiracles, each in a round yellow or reddish spot. The chrysalids are mostly pale greenish or of a pinky buff, variously marked with yellow and spotted with brown, and of a brown colour at the two ends. Eggs pale green, becoming paler, otherwise of the shape, and placed like those of the Small White (*P. rapæ*).

The Green-veined White (*P. napi*) is said by Dr. Taschenberg to be the least frequently met with of the three kinds of butterflies, but still to be always quite common enough.

Where a numerous visitation of these Cabbage pests is present in garden or field, it is difficult to distinguish the butterflies excepting by size, the Large White (see p. 1) being considerably larger than the other two kinds. The caterpillars, however, may be distinguished from each other by the few chief characteristics mentioned above; and full description of the three species in their early stages from egg to chrysalis will be found at pp. 148–159 of the work referred to (*ante*) at p. 2.

Prevention and Remedies.—In the course of the infestations of the past two seasons I have tried two preventive experiments on the Cabbage beds in my own garden, the first of which (in 1898) so *totally failed* that it may perhaps save waste of time to others just to mention it. At my desire my gardener dressed the plants with a good mixture of lime and soot, well powdered and thrown on the leaves. This did *not* appear to do the least good. The leaves were eaten back until little or nothing remained but the mid-rib and the side veins standing or hanging like strings, and of the plants which recovered so as to make something like growth, the result was really hardly worth cooking.

In the past season I was much more successful. Not long after the White Butterflies appeared as a regular infestation my gardener syringed various kinds of the Cabbage plants in the different beds with the mixture known as Little's Antipest. This is a mixture of soft soap and mineral oil, so far as I am acquainted with its chief ingredients; in fact, may be described as our British counterpart of the "kerosine emulsion" which is so greatly and successfully used in the United States and Canada for destruction of caterpillars, as a spray on leafage. Shortly after the syringing there were noticeably fewer White Butterflies in the kitchen garden than in the flower garden adjoining, and the result was such a much smaller appearance of caterpillars that, though two beds were a good deal injured, the other two borders and some lines of luxuriant Cauliflower plants were practically little harmed, and even the two first-mentioned were in fairly good order; whilst in various other gardens in the neighbourhood the condition of the attacked plants was stated to be nearly or quite as bad as in 1898. From this success (although only on the scale of experiment in my own garden) it seems to me that the plan would be at least worth trying for garden use.

For those who may care to try the kerosine emulsion itself, I give below one of the U.S.A. Dept. of Agriculture recipes for proportion of ingredients and method of mixing,* but to those who have not the knack of combining the soap-wash and oil the process is very tedious, and unless these are so thoroughly incorporated as *not to separate*, the application is likely to be very injurious from the (then) undiluted mineral oil burning the leaves.

For this reason I use the so-called Antipest sold by Messrs. Morris, Little & Son, Doncaster, as it only requires diluting, and I have found it answer very well as an insect wash, and save both time and risk.

It might be well worth while to try the effect of syringings with a solution of soft-soap without any addition. This would be to some degree a deterrent of attack, and would help to some slight degree to support the plants by causing a damp air round them, and moistening the surface of the ground with a slightly stimulating wash *without at the same time attracting* the White Butterflies. Their attack is most prejudicial in hot and dry weather, and, so far as my own observation goes, the application of water alone is almost immediately followed by an increased amount of prevalence of the butterflies on the beds.

With regard to lessening amount of caterpillar attack by capture of the butterflies, I was favoured with the following notes by my valued correspondent, Mr. W. Bailey, Head Master of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, where, under his able superintendence, and with the full approval of the governors and of the neighbouring agriculturists, very serviceable work in attention to injurious insect prevention has been given by the boys for many years. Mr. Bailey mentioned:—

"This summer we have had quite a plague of the White Cabbage Butterflies, and dreadful havoc they have made among Cauliflower, Brocoli, and Cabbage plants. Many crops have been completely ruined in our neighbourhood. On August 9th, 10th, 11th, 14th, 16th, 21st, and 23rd, I put two boys at a time in my little garden of about a quarter of an acre with a net each to catch these butterflies. The boys were delighted to spend their dinner-hour in this work. On some of the days the boys were not engaged in this task for more than an hour. On other days when two boys had been 'hunting' for half-an-hour to an hour, they were relieved by two other boys. And now for

* 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.

the result of this juvenile labour. In these *seven days* the boys caught and killed *834* of these butterflies. My winter vegetables are in excellent condition, as they have been free from caterpillars, while, as I have said, many crops in the district have been destroyed by these pests. It has been a capital 'object-lesson' not only to the boys, but also to many others in the locality. You will probably remember that last year I allowed the eggs to be laid and hatched and the caterpillars to feed for some time on the plants, and then put the boys to collect them. From two hundred and forty plants they gathered more than 5000 caterpillars."—(W. B.)

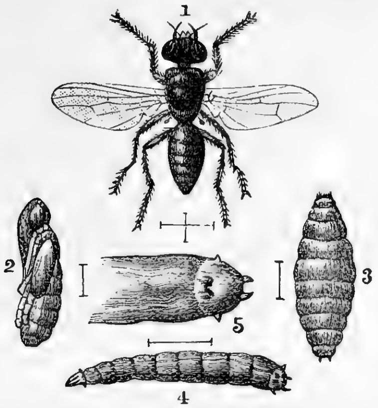
Where Cabbage is grown as a field crop, probably neither hand capture nor syringing could be brought to bear, but there are very many gardens where for an extremely small sum a couple of boys might at an hour a day for a few days do a deal towards preservation of the Cabbage and Cauliflower supply for house service. Syringing may very easily be managed without inconvenient loss of time for the few successions of applications needed.

Other remedies, such as waterings over the leaves of lime-water, or of weak brine, or of soap-suds, have been entered on before, and it cannot fail to lessen amount of coming attack to search as soon as the first chief amount of caterpillars has disappeared in summer, and also again in winter, for the chrysalids. These will be found in all kinds of garden shelters. Indoors they may be found in outhouses, potting-sheds, or the like places, in every neglected corner, as, fastened against rough walls, woodwork, or mortar, under beams, or shelves, or rough stairs, &c. Out-of-doors they may be found under eaves and pieces of rough timber, broken boards—anywhere, in short, where there is convenient and dry shelter. Clearing these out will do a deal of good, but will by no means necessarily prevent attack without co-operation in a neighbourhood, as the flocks of butterflies come on the wing.

Turning poultry on to infested ground is much recommended by some observers, but it has its drawbacks in the quantity of mischief the poultry may do if the expense of paying a watcher is not gone to. Also there is a possibility of the diet disagreeing with the birds unless some care is taken. Personally I believe that, where there are the very great insect infestations to which the aid of poultry is called in as a clearing appliance, it is prudent not to let the birds be on the ground for more than half the day, and also to be very sure that they have other food. If they had their morning meal before being driven afield, it would probably prevent them gorging themselves, and save losses which certainly in some cases—as when hard insects have been fed on to repletion, and conjecturally in others—have been rather attributable to the mass of undigested food than to any bad quality in it if consumed in moderation.

CHEESE.

Cheese and Bacon Fly. *Piophila casei*, Linn.



PIOPHILA CASEI.—1, fly; 2, pupa; 3, pupa-case; 4, maggot,—all magnified, with lines showing natural length; 5, tail extremity, still more magnified, showing spiracles, tracheæ, and caudal tubercles.

Most of us, especially those who have to do with manufacture of Cheese, are only too well acquainted with the small white "hopper" maggots which put head to tail, and then, letting go suddenly, disperse themselves by "hops" or "skips" in all directions.

The infestation is prevalent in America as well as Europe, and is perhaps one of our longest definitely known economic insect pests, as the grubs, which "form themselves into an arch and leap in fat Cheese," are recorded as a North European trouble so far back as the year 1555.*

"Live Cheese," as it is called, is a cause of great loss where the infestation is not looked after in its early stages, though I am assured by various lady dairy superintendents who have been good enough to communicate with me, that by the use of careful preventive measures they suffer little; and in the course of the following pages I give notes of the treatment regarding which they have been good enough to let me have information.

But the great injury sometimes caused to Bacon and Ham by the "hopper" maggots of the same kind of fly (*Piophila casei*, scientifically) is much less known of, or at least much less acknowledged, and brought forward as a thing to be got rid of. It might probably save a deal of loss if this fact—that is, the similarity of the infestation—was

* See observations on "fat" Cheese, and note, p. 15.

more generally known; and as it was in my power in the last season to gain some useful information as to presence and prevention of the infestation on a large scale, as observed in the premises of one of our large Curing companies, I give in the pages 10, 12, and 13 the notes which they have been good enough to allow me to use, under promise to withhold any names which might lead to knowledge of locality.

These maggots are the larvæ of a slender shining black two-winged fly (see figure, p. 7), scarcely the fifth of an inch in length. The abdomen longly elliptical, somewhat depressed, and with some amount of fine hair at the sides and tip, Customarily the fore legs are black, with some reddish yellow at the hips and knees; and the middle, and hinder pairs, reddish yellow with some mixture of black. The wings transparent, overlapping at the edges nearly to the tips when in repose, and with pale veins.

The eggs are white (possibly sometimes pinky), slender, oblong, slightly curved, and one millimetre—that is, about half a line—in length. These are sometimes deposited singly, sometimes in clusters of from five to fifteen, and as many as thirty may be deposited by a single fly. The duration of egg condition may only be for thirty-six hours or less in summer, but appears to vary with temperature.*

The larvæ, or maggots, are whitish in colour, and legless, smooth, and shining, cylindrical in shape, tapering to the head, and truncate or somewhat rounded at the tail extremity, which is furnished above with two horny "stigmata," or spiracles, the tracheæ, or breathing-tubes, connected with these breathing-pores being clearly visible through the thin skin; beneath are a pair of fleshy processes, and there is a smaller process at each side. (See figures 4 and 5, magnified, and greatly magnified, drawn from life, at p. 7.)

When full grown the maggot measures about a third of an inch in length. The head extremity is furnished within with a pair of hooks, which serve for collecting its food, or at pleasure (when it has completed its growth, which may be in about seven or eight days) may help to drag it to the spot selected for turning to chrysalis state. These hooks are also of service in the very noticeable habit of the maggot of putting head to tail and taking long skips, or leaps, which is thus described in detail †:—"When about to leap the larva brings the under side of the abdomen toward the head while lying on its side, and reaching forward with its head, and at the same time extending

* For detailed information on this attack, see "The Cheese or Meat Skipper," by Mary E. Murtfeldt, 'Insect Life' of Dept. of Agriculture, U.S.A., vol. vi. pp. 170–175; and also "Cheese Skipper or Ham Skipper," by L. O. Howard, in 'Principal Household Insects of the United States,' Bulletin No. 4, New Series, Dept. of Agriculture, U.S.A., pp. 102–104.

† See observations by Prof. Putnam in Dr. Packard's 'Guide to Insect Life.'

its mouth-hooks, grapples by means of them with the hinder edge of the truncature, and, pulling hard, suddenly withdraws them, jerking itself to a distance of four or five inches." The length of the skips is variable, but the unpleasant habit is only too observable.

When full grown the maggot is stated to move from where it fed to some comparatively dry spot, as, for instance, the wrapper of the Cheese, or possibly of the Ham, where it has been feeding, and there it contracts to about a fifth or sixth of an inch in length, and first changes to a yellow tint, then to a golden or red brown, the outer coat becoming hard and much wrinkled at the head extremity, and still more so at the tail. This puparium, or chrysalis-case, is elliptical, about a fifth of an inch in length, and from this the fly emerges in a time that may vary from thirty-six or forty-eight hours to from eight to ten days. The longer time is given in German observations, the shorter in U.S.A. observations, and the variation may probably depend on weather and temperature. In observations on the life-history by Dr. Kessler, he found that the average time in developing from egg to fly condition is four to five weeks, with two or three generations during the summer, the last generation occurring in September, and the maggot passing the winter in the puparium—that is, in the brown chrysalis-case, and turning to the pupal state within it in May.

The chief points of the habits of the infestation, as given by comparison of the published information of the United States and European records, together with some notes of observation of attack both to Cheese and Bacon in this country, may be condensed into a small compass as follows.

The infestation (*Piophila casei*) may pass the winter either in fly or in chrysalis state in any convenient place, as in crannies, crevices, behind boards, anywhere, in fact, where it can hide away, and from these shelters, unless exposed to "severe and protracted cold," by which (it is said in recent observations) "larvæ, pupæ, and flies are killed," the flies come out in spring. The first application which I received in the past season regarding attack was sent me on the 29th of March, with the remark that the Cheese-room "is swarming with them now."

The flies chiefly select for egg deposit Cheese and cured meats, as Ham and Bacon, and to some (though a much lesser) extent, Salted Beef. Rich, or, as it is sometimes called, "fat," Cheese appears to be especially preferred, and they likewise attack cream Cheese. There appears no doubt that it does not lay eggs on fresh meat, and Smoked Beef is "to some extent" subject to attack, but Ham and Bacon are the special subjects for egg-laying so far as concerns cured meats. The details of nature or condition of material—namely, of the Cheese and salted, or smoked; or salted *and* smoked Pork—chosen for attack, are given further on; but it is plain that salt cannot be utilized as a remedial agent, both from our constant broadscale experiences, and also as it was found by Germar that the maggots would live in common salt alone.

It will be observed in the details of life-history following, that it is such a marked and recognised habit of the flies to come in from out of doors through open doors or windows, that one of the regular preventive measures in the United States is to exclude them by fixing up screens of wire-work of a mesh sufficiently small to keep them out. In a case reported to me it was said, "We closed out and indoors with open canvas." But we have no observations (so far as I can see) *whence these invading quantities* of flies come.

In the following notes with which I have been favoured, I give them as received, as it would have taken from the value of the information to separate the observations of preventive treatment from those of condition of material accompanying; and as attack to Bacon and Ham has been least entered on in this country, I give the notes on this subject first.

Attack of "hopper" maggot to Ham and Bacon.—The following communication was sent me by the secretary of one of our Ham and Bacon Curing companies, which I am allowed to give, as well as some further observations on the attack and preventive measures, under promise of withholding name and locality of inquirers:—

"We are troubled with fly in our Hams under the following circumstances, and we are now venturing to communicate with you, believing you may suggest a remedy for the evil, which is a serious one to us. We find a small long pinky egg deposited in the Ham, sometimes in its early days of cure, say two to three weeks old, but more frequently when twenty-six to twenty-eight weeks old. The eggs burst and become a nest of white hoppers similar to those found in Cheese. . . . The Hams are sweet-cured, and we hang them separately to mature, but notice in the store-room several small flies; . . . and we think the later trouble results from these. It is puzzling, however, how the fly or hopper gets in when the Ham is only two or three weeks old. Could you suggest any solution or otherwise that would prevent these flies working, or hoppers forming?"

On July 10th, the Secretary of the Company above mentioned further communicated to me, enclosing a small piece of the infested meat, and also a little bottle containing some of the flies, which, he remarked, "you will see are as you describe—small, black, and two-winged."

The flies sent were about fifty in number, and corresponded with descriptions of the *Piophila casei*, popularly the Cheese and Bacon Fly. They were about one-fifth of an inch in length, black and shiny, two-winged, the wings transparent, and the neuration as given in the figure after Dr. E. L. Taschenberg at heading; the legs variable in tint, but more or less of a smutty yellow.

The maggots, of which such a good supply were sent me in the infested slice of Ham as to give excellent opportunity for observation, were (see figures from life at heading) about a quarter of an inch or somewhat more in length when extended, whitish in colour and cylindrical, tapering to the head extremity, within which the black mouth apparatus was very clearly distinguishable. The tail truncate at the extremity, which (as noticed at p. 8) showed at the upper part two small tubercular spiracles, or breathing pores, of which the connection of each with a *trachea* (or air-tube) was very plainly observable (with a two-inch object-glass); these tracheæ being traceable through the whole length of the maggot. At the lower edge of the obtusely truncate caudal extremity was a pair of somewhat pointed fleshy processes, and on each side a single smaller blunt process was observable.

Previous to leaping, the maggot fixed its black head-hooks with great care to some part of the tail extremity (taking an appreciable amount of time to arrange this matter to its satisfaction), lying the while on one side, and forming a circle of about an eighth of an inch across; but, so far as I could see, it was quite immaterial which part of the truncate end of the tail was laid hold of. Then, suddenly letting go, the maggot "skipped" to a variable distance—it might be of about an inch up to about three inches or more—and the operation was most energetically carried on by the collection of maggots which I had under observation, which dispersed themselves in all directions, falling with an audible noise on the sheet of paper on which I was watching their movements.

On July 15th, two *puparia* or chrysalis cases were noticeable. These were cylindrical, but lessening to the head end, and somewhat smaller at the tail, which retained to some degree the spiny processes of its maggot condition. Length, little more than half that of the maggot when *quite* full grown and *quite* fully extended; colour bright chestnut, excepting towards the head extremity, which was rather darker in tint, as also (but to a very slight degree) the tip of the tail. A few of the collection of larvæ under observation were still at this time in quite young state.

On July 18th about thirteen puparia were formed, and there were larvæ of various sizes—from somewhat less than the sixteenth of an inch in length up to full growth—in the box with the piece of "skipper"-infested Ham.

The first specimen of the imago—that is, of the perfect fly of *P. casei*—was developed from my specimens on July 23rd.

The piece of Ham showed the great damage caused by the maggot workings well. This slice was about four inches long by two and a half broad, and a quarter of an inch thick, and in this the piece of fat overlying the meaty part (about an inch across at the widest part and two inches in length) showed distinct perforations caused by the maggots, and other injury caused by the attack, so that it was separable as a layer from the meat; but in the other parts of the slice I did not find any maggot-damage either to the solid meat or to the solid fat, only to the softish fatty part between the fat and lean attached by one side to the meat.

The following communication was sent me by my correspondents regarding Ham "skipper" infestation in course of some special correspondence, and contains serviceable information relatively to salt having *no* bad effects on the maggots, and other useful points of observation.

In regard to the enquiry whether the maggots were born in the Ham after the death of the pig—taking the word "born" here and also the word "germinate" in the second line of the communication to be equivalent to "hatch"—the maggots would hatch from eggs laid by the fly after the meat was salted. It appears to be quite proved that this Bacon and Cheese Fly will not lay eggs on fresh or unsalted meat, and, taking the liberty to alter one word of which the technical meaning is not quite certain in my correspondent's leading sentence, it is perfectly correct "these insects [hatch], live and thrive in salted meat."

I subjoin their serviceable communication verbatim:—

"July 13th, 1899.—There is, we think, no doubt but that these insects germinate, live, and thrive in salted meat. We think that in the late spring there were *no* flies nor maggots in our curing-room; since then and until lately we have had heaps of them—perhaps millions! These are *sweet*-cured Hams, and the saccharine matter may help on the germination and development. If *salt* does not favour them, it most certainly does not destroy them. It is common in Bacon-curing to find that maggots multiply and develop in the salt used in the curing of the Bacon, and that where there is no trace of taint. We think that these maggots came of flies which deposited their eggs in the meat *soon after slaughter*, and we found that the salt did not destroy their progeny. The Bacon keeps damp, even wet, from the salt and from the Bacon being stacked side upon side; but we are not conscious of the being of these maggots in the curing-room, as they show up *after* the Bacon has been smoked and dried. Are we wrong in supposing that these maggots were born there soon after the death of the Pig? The smoke of the drying-stove, with its heat, did not destroy them. Then, further, these *sweet* Hams are kept *after* cure in dry, well-aired rooms. These small flies and maggots begin their life and work after the curing, and in course of the drying."

On Aug. 1st the following letter was sent me, which shows that some amount of remedial measure was being satisfactorily brought to bear on the infestation by the use of a fly powder :—

"I am happy to tell you we are finding that by a free use of a fly powder * we are clearing our store of a large number of insects. We still have much trouble with the cured Hams. . . . We find the mischief caused so soon after curing, that we are arranging to bag the Hams immediately they come from the curing-room, and dry the Ham and the bag together."—(Communication from Ham-curing Company.)

In the observations quoted previously a passage occurs regarding egg-laying of this fly :—"I have not been able to make it oviposit on fresh meat of any kind, nor does it seem able to breed upon that which is simply salted." . . .

Relatively to how far this latter point might be the case in broad-scale trade treatment (that is to say, whether the fly would not attack salt meat *unless also smoked*), I made some special enquiries from the Company, from which I received a good-sized sample of very thoroughly "hopper"-infested Ham, and was favoured by them with the information that their "*Hams were not smoked*," and suffered much more than the smoked Bacon. Their reply was as follows :—"With reference to the fly being attracted by smoked meat, we do not attach so much importance to the actual condition of the meat as to the condition of the atmosphere in which the meat is kept, and whether such is favourable to the fly or otherwise.

"Our Hams are not smoked, but sweet-cured and dried. It has always seemed to us that the peculiar aroma from these Hams has been attractive to the fly. We may say that in our business we have large quantities of smoked Bacon, but we do not find this suffers in anything like the same degree as the Hams. The fact that the flies do not breed so much in salted meat as in smoked is probably owing to the fact that the former is kept in cellars of low temperature."—(Sec. of Curing Co., referred to.)

The records of the method of attack of this fly to Ham and Bacon given in 'Insect Life,' vol. vi. (referred to in note, p 8, preceding), agree with what I was able to notice in the specimen sent to myself for examination. "The lean meat was never in any case penetrated, . . . nor was the solid fat much damaged. . . . Myriads of 'skippers' and puparia, in all stages of development, were found in the packages reported on, clustering round the bony ends of ham and shoulder, and in the *softer fat*, and oil-saturated folds of the canvas wrappers."

* Keating's Fly Powder might very likely be useful.—E. A. O.

The following notes on prevention and remedy of attack of P. casei to Bacon are given by Miss M. E. Murtfeldt in the paper in 'Insect Life,' vol. vi. No. 2, p. 175, referred to in note at p. 8, preceding. "When exposed to severe and protracted cold, larvæ, pupæ, and flies are killed. The flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon them, produces the same stupefying effect that it does upon other Diptera" [two-winged flies]. "The firm in whose behalf these investigations were undertaken informs me that in order to exclude the fly they screened all windows and doors with a twenty-four to the inch wire mesh.

"They also, early in the spring, thoroughly whitewashed and fumigated smoke-houses and store-rooms, using an admixture of carbolic acid in the whitewash, thus effectually sealing up or killing all hybernating individuals that might be lurking in these places."

In Bulletin No. 4, U.S.A. (referred to at p. 8, preceding) it is also mentioned "that close screening of the windows of pantries is advised to keep out the fly." Whether for preservation of Bacon or Cheese, such arrangements as may thoroughly prevent entrance of the flies are very important.

Piophila casei as a Cheese attack.—The first inquiry regarding this as a Cheese infestation was sent me on the 29th of March in last season from a farm in Shropshire, as follows:—

"We are troubled very much with a small fly that I never *saw* until last year all about the house. I make Cheshire Cheese, and the room is swarming with them now, and summer time; there are not any Cheeses in the room now, but flies are there. I perceived the air swarming with them. They are half the size of an ordinary fly, and I fancy they enter through the window when open."

A corroborative sample of flies was enclosed, with some further remarks as to the attack of the flies to the Cheese, and the great consequent mischief likewise, the Cheese being "fat." This point (that is, the *richness* of the Cheese), also the very great numbers of the flies, and also the point of their effecting their entrance through the window when open, are all matters for special notice connected with the infestation, and the latter very especially relatively to available methods of forestalling attack.

With regard to observation of jumping maggots in "fat Cheese," so far back as the year 1567, it is of interest to notice that in the 'History of the Northern Nations,' by Olaus Magnus, Archbishop of Upsal, printed at Basle in the year 1567, at p. 812, after an enumeration of various kinds of worms or grubs, it is mentioned that there is also another kind of grub which infests Cheese, leaping in the shape of a bow in fat Cheese, and which no cold destroys. The passage is as follows: "Vermis deniq; alius caseorum, saliens instar arcus in pinguibus caseis, qui nullo frigore interimitur."—(O. M.)*

No name is given to the infestation, and it can by no means be said that this ponderous and ancient volume is a safe guide in scientific or many other respects; but, taking the characteristic points of this maggot leaping in an arched form in Cheese, and also in "fat Cheese," it seems in all reasonable probability to be our widespread pest of the present day—*Piophila casei*, Linn.

On applying for information regarding Cheese Fly attacks to Mr. Richard P. Ward, Organising Secretary of the Cheshire County Council, he was good enough to procure the following observations for me from Miss Foster, Chief Instructress at the Dairy Institute at Worleston, where, in 1898, almost sixteen tons of Cheese were made by the students under her direction. Miss Foster kindly reported as follows:—

"The best remedies I know are thoroughly lime-washing the walls every year, painting all the woodwork, and cleaning the floors thoroughly with soft-soap; this prevents the eggs hatching out.

"At the very commencement of the fly season fly-papers and other fly-killers should be used, so as to destroy as many as possible. All damp straw should be moved, as moisture is necessary to the fly when depositing its eggs. All cracks in the Cheese should be filled at once with a mixture of flour, butter, and pepper. Of course the Cheese should be turned daily, and a careful watch kept for cracks and fly-deposits. If the flies have obtained an entrance into the Cheese, the best thing is to cut out the affected part, dust thoroughly with black pepper, refill with Cheese, and cover carefully with calico.

"The Cheese should be moved each week, and the floor and benches thoroughly scrubbed.

"Some people use lime to fill the cracks, but it destroys the colour of the Cheese. Old-fashioned people think that branches of alder and ivy hung in the room will drive away the flies, but I have proved this to be a fallacy. The great thing is to destroy the flies."

On July 12th Mr. Robert Challinor, Secretary of the Cheshire Dairy Farmers' Association, writing from 22, Old Bank Buildings, Chester, was good enough to give me the following remarks:—

"I am glad to say that there is very little complaint amongst our

* See 'Historia Olai Magni Gothi Archiepiscopi Upsalensis, de Gentium Septrionalium variis conditionibús statisubue,' &c. Basileæ ex officina Henric Petrina. M.D.LXVII. The Archbishop's special preface is dated a few years earlier from Rome: "Romæ 4 Nonas Januarias Anno salutaris partus M.D.L.V." The above extract is taken from the division on insects, Liber xxii. cap. viii.; and, as I am fortunate in possessing a copy of this rare old book, I have quoted the references at length, as sometimes they are variously given, presumably from their being taken from the various editions.—(E. A. O.)

dairymaids of the fly trouble. Where it does appear, certainly it creates loss and gives trouble, but if they are careful they can prevent it appearing; and if it is there they can get rid of it by scraping out the crack and filling it with flour or borax; but it is important that this should be done with as little delay as possible to prevent further mischief being done."—(R. C.)

Mr. Challinor further obliged me with a few notes from Cheese-makers, from which I give the following extracts without names of contributors:—

"Mrs. B says that she has rarely had any trouble with the fly. She has an idea that keeping the Cheese in a good sound condition and the room dark is a certain preventative.

"Mrs. C says that occasionally she has been troubled with the fly, but its visit has always been traced to neglect in leaving some crack or opening in the Cheese exposed.

"Mr. D says that in most cases the Cheese leave the farmer's room before the flies can give much trouble. In his opinion, to find the effects of the work of the fly in its worst form we should follow the Cheese to the warehouse or the place where they are stored before they are distributed for consumption. The dealers or factors I know to have suffered severely on account of the fly developing in the Cheese, very often through a little neglect on their part in not giving attention to the places where they have been bored for tasting; but I believe that most of them now make one of their men responsible to see that they have the attention needed.

"*Hot steam.*—I should think that hot steam would destroy either maggot or fly, but few farmers could manage this. No boiler or other convenience at their disposal."

The above notes from "B," "C," and "D" contributed by Mr. Robert Challinor.

The remarks relatively to "hot steam" are in reply to some inquiries of my own as to how far this application might be considered serviceable where steam power *was* available. It is now a good many years since I was consulted as to some practicable method of getting rid of this Cheese Fly infestation on a large scale, and, as steam power in this instance was at hand, I suggested turning on hot steam by the hose into the Cheese-room or store, with the view of killing maggots, chrysalids, and flies—in fact, destroying the infestation in any stage in which it might be present by *scalding it out*. As matter of course, the store-room was cleared of Cheese before the current of hot steam was applied. This was several years ago, and, not being working on stored material of this kind at the time, I did not keep the notes, so I am unable to give report of results verbatim, but I understood that the treatment was successful.

Continuing the observations of Cheese Fly habits and prevention. On June 14th I was favoured by the following notes from Mr. D. E. Byrd, of Spurstow Hall, Tarporley, Cheshire:—

"Of course prevention is better than cure, and that, we carry out by keeping the Cheese-room as dark as possible. Of late years we have put calico caps on the Cheese, as well as the binders, which effectually keep all flies, beetles, &c., from the Cheese; but, should any Cheese be affected, flour and pepper is put in the affected part, which will probably kill the maggot, and the crack can be filled with soft Cheese."—(D. E. B.)

In a subsequent letter (on June 23rd) Mr. Byrd mentioned: "One of our leading Cheese makers always uses quick-lime as a cure for the maggot in Cheese."

The following observations from a leading cream Cheese maker in the United States, quoted from 'Insect Life,' vol. vi., previously referred to, draw attention to treatment requisite to prevent entrance of the flies through open windows, and measures for catching such as may be found present:—

"We are always somewhat troubled with the Cheese Flies in summer. To keep them out of our storerooms we cover the windows with light domestic, as they will go through the ordinary wire-screen; but, as there will always be more or less of them in the rooms, we have the brown fly-paper in water always on hand, which keeps them pretty well in check."

Another note immediately following from a large Cheese manufacturer mentions that he "depends mainly upon fine screens to keep out the fly, and also darkens his storerooms; has each Cheese rubbed hard each morning; uses no chemicals but a Cheese grease that contains some rosin which gives a hard coating."

Prevention and Remedies.—The various observations show that, where the infestation is neglected, the fly multiplies enormously, and the losses from maggot attack whether to Cheese or Bacon are great, but that preventive treatment reduces these losses to an immaterial amount. In the preceding pages the notes of treatment are given, together with those of the habits of the pest sent accompanying; but for convenience of reference I give below the methods of prevention advised, classed under headings, and as shortly as possible.

Prevention of fly presence.—To prevent fly entrance, it is recommended to exclude this *P. casei* by screening all doors and windows by a twenty-four to the inch wire mesh. If the mesh of the wire-screen is not small enough to keep them out, then similar use of light thin cloth is advised; this of course to be so fixed that the flies may not get in at the edges.* The brown fly-paper used by laying in water is serviceable in broadscale treatment, and any other fly-papers or fly-killers *which answer* these purposes are trustworthily recommended. I do not find that fumigation is much used with us, but in U.S.A. practice it is noted that the flies speedily succumb to the fumes of burning sulphur or pyrethrum powder, and the latter, if dusted upon the flies, stupefies them.† The Bacon Company whose notes I give at pp. 12, 13, preceding found a fly powder of great use.

The flies are not active at night, and to make the Cheese-rooms as dark as possible is one method with us of lessening attack; but the success of this would probably depend on the extent of the darkening, for if this is only partial the fly can still work.

Remedial and preventive measures to destroy infestation in maggot or other stage in stores or Cheese-rooms.—Thorough fumigation *early in the spring*, and also thorough whitewashing, using an addition of carbolic acid, "thus effectually sealing up or killing all hibernating individuals that might be lurking in these places" (M. E. M.).‡ Every crack should be carefully looked to which may be serving for a sheltering place from which the pest might wake up in fly, or develop out of chrysalis state, with the first warm weather.

Shelves should be kept carefully cleaned; floor and benches also thoroughly scrubbed, and (*wherever it can be used*) kerosene emulsion, or its British counterpart (soft-soap wash with a little paraffin or other mineral oil stirred into it), should be liberally scrubbed in. Careful attention to such measures as the above should be kept up during the whole of the season whilst the fly is active. As the maggot by no means certainly turns to chrysalis state in its feeding ground—indeed, in some cases certainly it seeks a drier locality—it is necessary to take such measures as may destroy such as are scattered, or sheltered near the food.

Where the stores *can* be emptied, and steam-power *is* present, it

* Note.—*Where do these flies come from?* It is plain from treatment to exclude them being a regular part of preventive treatment, that this entrance from outside is a part of the well-established life-history, and if we knew where they came from it might help us much. Do they propagate more than has been traced out at present in decaying filth? Taschenberg, in his *Piophila casei*, 'Praktische Insektenkunde,' pt. iv. pp. 141, 142, mentions that they were found by Germar to breed in human excrementitious matter when half decayed.

† Pyrethrum powder is procurable in this country under the name of Persian powder, and if fresh acts trustworthily; but probably it is well to see whether after a time the flies would revive, and if so to sweep them up and destroy them. The only objection mentioned to the use of the sulphur is that it was found to give a streaked look to the wash used by the firm (U.S.A.), who especially reported on it.

‡ It should be borne in mind that crannies in roofs and ceilings may shelter the flies as effectually as those in walls or floors.

might prove of use to try the effect of turning in hot steam (see p. 16, preceding); but it would assuredly be desirable, although I do not see this point brought forward, in the case of the scrubbings and washings with water, to use this at as great a heat as could be managed by the workers; and where scalding soft-soap wash could be "swilled" along floors, it would be pretty sure to make an end of all infestation that it touched.

Treatment to preserve material from attack, or to get rid of infestation when present.—One plan which is noted as having been found effectual after several years' trials is to put calico caps on the Cheese, as well as the binders. This keeps off Cheese vermin generally, as flies, beetles, &c.

Preservation of Hams from attack by securing them in bags is alluded to from various quarters, but I do not find any working recipe for this treatment, except mention in one instance that the Hams were rubbed with black pepper before putting them in the bags. It is plain that the advice given in regard to bagging Hams to protect them from the "Ham *Beetle*" is equally applicable for Ham *Fly* in respect of the material used being strong enough for there to be no risk of holes being broken in it by accidental rough treatment. Also holes gnawed by mice would require to be looked for, and also care would need to be taken that the material used, whether canvas or otherwise, was such as would allow no chance of maggots laid by the flies outside the bags making their way through to the cured meat within. The egg of *P. casei* is only about one-twenty-fifth part of an inch in length, and about a quarter of that measure in width—that is to say, about one-hundredth part of an inch in width; and the young "hopper" maggots on their first hatching from an egg of the above-mentioned size might presumably make their way pretty easily through material not carefully chosen to allow of no passage. Bags afford sheltering places in their folds for the infestation, and up to date of observations some application which might be deterrent to fly and maggot presence, and non-injurious to the Ham within the bag, seems to be a great desideratum.

To clear eggs from the Cheeses before the maggots hatch, it is recommended that each Cheese should be rubbed hard every morning—one U.S.A. observer notes, "We usually go through the rooms twice a day and look for eggs"; also the use of a Cheese-grease that contains some rosin, and which gives a hard coating, is advised.

Portions of Cheese and Ham that are found to be attacked should be cut out, and as soon as possible after observation; and, with regard to Cheese, it is recommended that, after cutting out the piece, a thorough dusting of black pepper should be given, and the cavity refilled with Cheese, and covered carefully with calico. A careful watch

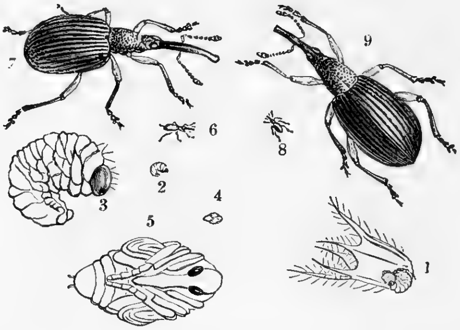
c 2

should be kept for cracks, and all cracks in the Cheese should be filled at once with a mixture of flour, butter, and pepper. The Cheese should be turned daily, and moved each week.

Another contributor mentions flour and borax as a mixture to be used after scraping out the infested crack.

CLOVER.

PEAR-SHAPED WEEVILS—Purple Clover Weevil, *Apion apricans*, Herbst. (=*A. fagi*, Kirby; *A. flavifemoratum*, Kirby); *Apion assimile*, Kirby (? var. of above). **Clover-head Weevil,** *Apion trifolii*, Linn.



6, 7, *Apion apricans*; 2–5, maggot and pupa; 8, 9, *A. assimile*—all natural size and magnified; 1, maggot feeding.

Clover crops, and most especially those of Red or Purple Clover (*Trifolium pratense*), suffer much from time to time from the depredations of a few species of *Apion*, popularly known as "Pear-shaped Weevils." These beetles are of very small size, from rather less to rather more than a line in length, somewhat oval in shape, and furnished with a long and slender proboscis, more or less curved as the case may be, giving to the beetles (when examined by a magnifier sufficiently powerful to show the form) a likeness in shape to a miniature Pear, together with its stalk—whence the popular name of Pear-shaped Weevils.

There are many species of this genus in Britain; as many as about seventy-five are recorded as present, which for convenience of reference are divided into groups; and of these Group 6, of which the upper surface is black, the legs wholly or in part red, and the pubescence very slight or absent, are chiefly found on species of *Trifolium*.*

The three kinds most injurious to Red or Purple Clover (*Trifolium pratense*) are, first, *Apion apricans*, Herbst., known also as *A. fagi*, Kirby, and *A. flavifemoratum*, Kirby; second, *Apion assimile*, Kirby, which formerly stood as a distinct species, but which now, from its very slight variations from the species above mentioned, is considered by some of our leading coleopterists should only take rank as a variety; and third, *Apion trifolii*, Linn., which is rather smaller than *apricans*, and has the proboscis much less curved.

These kinds, so far as I have seen from specimens sent, and also as noted by Dr. Taschenberg,† are similar in their life-history; and as the above-named kinds or varieties may all be present together, it is almost impossible on the broad scale of field cultivation to say which of the kinds may be doing mischief, beyond those of which specimens are sent for identification.

The life-history of the Purple or Red Clover Weevil, which it appears may be taken as that also of *assimile* and *trifolii*, may be given shortly as follows. The beetles live through the winter, and when the Clover has run up to blossom the female weevils lay their eggs in the flowering-heads. The maggots which hatch from these eggs pass through the calyx to the forming seed, on which they feed. They are stated to make their way into the seed and feed on it until it is consumed; then they make their way out, and turn to chrysalids in the flower-head amongst the dying blossoms. (In my own examinations I have found little maggots free in the flower-heads.) These are little fleshy larvæ of the shape figured at p. 20, with rather horny heads, and scarcely a line in length, and legless. They usually lie somewhat curved together.

The chrysalids may develop into weevils in about a fortnight in summer, and thus furnish a second brood, of which the beetles attack the Clover leafage, sometimes to a very injurious extent, and when the flower-heads of the second crop of Clover are sufficiently advanced for infestation, set attack on foot precisely as on the earlier crop, excepting that it may remain in chrysalis state throughout the winter.

The following detailed description of the larva and pupa of *Apion apricans* by Mons. Guerin-Méneville is given for service where minute reference is required, to which is added some further description of the

* In many points of technical description of characteristic differences between the beetles, and also with regard to considerations of *A. assimile*, Kirby, being now considered by various qualified writers as being not a separate species, but one with *A. apricans*, I am much indebted to information given in 'The Coleoptera of the British Islands,' vol. v. pp. 145 and 148, 149, by the Rev. Canon W. Fowler, Secretary of the Entomological Society of London.

† 'Praktische Insektenkunde,' pt. ii. p. 181.

same species under the synonym of *fagi*, by Georg Ritter von Frauenfeld, which gives a few additional points useful for identification:—

"*Apion apricans*, Schœnh.*—The larva is scarcely two millimètres in length, thick, arched, and slightly resembling the 'white grub' of the Cockchafer in shape. The head is reddish, a little horny in texture, and armed with two strong mandibles. On each side and near the insertion of the mandible, a very small smooth eye, and below this a small articulated style, which represents the antenna. The three first segments of the body, those of the thorax, are sufficiently well marked; they do not bear feet, properly so called, but each has beneath it two fleshy tubercles, which certainly take their place. The segments of the abdomen are not well determined, beneath they are mamillated; the body is entirely glabrous, without colouring. . . .

"The chrysalis is nearly as large as the larva, white, rather soft. The head is bent downwards; the wings, elytra, and feet are folded on the sides and beneath; the third pair of feet is separated from the others by the elytra, and the antennæ are not elbowed, and are laid by the head with an upward direction ('*en se dirigeant en haut*').

"The larva lives at the base of the calyx of the flowers of the common Trefoil (*Trifolium pratense*). It gnaws the grain which is to be found at this spot, and pierces a hole in the side of the flower, by which to escape from it, and changes to the chrysalis amongst the various flowers of the flower-head."

In the short descriptions of the larva and pupa of the above species (*A. apricans*), given under the synonym of *A. fagi*, L., in the 'Zoologische Miscellen' of G. von Frauenfeld,† especial mention is made of the "extraordinarily long" proboscis of the pupa, which reaches far along the body, and is but little covered by the elytra. The other details are so similar that they do not require repetition.

The above observations of the life-history and early stages of *A. apricans* are given in detail, as, so far as is known, these appear to be so similar in the three kinds of weevil under consideration as to be indistinguishable to all ordinary observers; and those of *A. apricans* have been the most fully described. Similarly with regard to these three species, when developed to perfect, that is beetle, state, it is impossible for all but skilled observers to identify them as distinct species trustworthily without some special guidance; and as it is to

* 'Annales de la Société Entomologique de France,' deuxième série, tome premier, p. 66: "Notice sur les Métamorphoses de *l'Apion apricans*," par M. F. E. Guerin-Méneville; 15 Février, 1843. So far as I am aware, this description, although published so long ago, is still the fullest and best that we possess. The paper is illustrated, but I omit references to the figures, as it was not necessary to copy the plate.—E. A. O.

† Georg Ritter von Frauenfeld in 'Verhandlungen der K.K. Zool.-botan. Gesellschaft in Wien,' xvi. Band.

a great degree by characteristic differences from *A. apricans* or *A. fagi* that they may be distinguished, it has seemed desirable to give one authoritative description of this species verbatim, and this I accordingly quote from Canon Fowler's work on British beetles referred to below.*

The full description of the beetle of *A. apricans* is:—"Black, glabrous, rather shining; forehead rugosely punctured, rostrum long and slender, slightly curved; antennæ black, with base reddish; forehead rugosely punctured; thorax oblong, oval-cylindrical, rather closely and distinctly and regularly punctured, with a central channel behind; elytra obovate, with strong punctured striæ, interstices rather broad; legs black, with all the femora and the anterior tibiæ reddish testaceous. Length 2–2½ mm.

"Female with the rostrum longer than in male, and the elytra deflexed and callose behind."

The usually received differences of *assimile* from *apricans* are stated by the same writer to be as given by Walton (in Ann. and Mag. Nat. Hist. 1844, p. 87), that *A. assimile* has the rostrum in both sexes *distinctly more curved*, and, in the male, attenuated in front; also it has the basal joints of the antennæ *dull piceous*, and the thorax *closely punctuated, with the punctures confluent;* also *A. assimile* is smaller than *A. apricans.*

Apion trifolii, it is stated, may be distinguished from *A. apricans* by having the *anterior trochanters pitchy*, and the *four posterior trochanters black*, whereas in *apricans* they are all rufous; the antennæ are relatively shorter, and are *entirely black;* the rostrum is very little curved, and the general form shorter; the average size also smaller. Length 1½–2 mm. (See 'Coleoptera of British Islands,' vol. v. p. 149.)

Apion trifolii.—Towards the end of June in the past season I received, per favour of the editor of the 'Farmer and Stockbreeder,'† some specimens of Clover-heads from near Ampthill, which were infested by small maggots; the attack, so far as could be judged in its then condition, being of *Apion apricans*, or one of its near allies (see preceding descriptions); and shortly after some more Clover-heads were forwarded me from the same locality containing some of the developed weevils. These proved on investigation to be of *Apion trifolii*, Linn., and though this is often found with the two above-named kinds, on this occasion all the eleven specimens sent proved to be *trifolii.*‡

The only other occasion on which I have had specimens sent me which were certainly of this species was in the beginning of September

* 'Coleoptera of the British Islands,' vol. v. p. 148, by the Rev. Canon Fowler.

† See number for June 26th, 1899, p. 954, col. 2.

‡ As I wished to be perfectly certain of the kind, I availed myself of the courtesy of Mr. O. E. Janson, F.E.S., for specific investigation.

in the year 1886, when heads of Purple Clover infested by Clover Weevil were sent from Girleston, West Buckland, Somerset, where the maggots were doing much harm to seeding Clover. About fifty acres (which were being saved for seed) were noticed to be infested by small white maggots, which were feeding at the base of the florets, and it was stated that every field of Clover in that neighbourhood was similarly attacked.

At the same time a similar attack on seeding Clover was reported from the neighbourhood of Enmore Park, Bridgwater. In this instance it was stated that in each head there were small white maggots, generally five or six in number; and that whole crops had been destroyed, the observer having found "scarcely a single plant unattacked."

Here also I found *Apion* maggots in the Clover-heads sent; little fleshy white maggots, with brown heads, of the shape figured at 2, and 3, magnified, p. 20. The maggot was of the characteristic form of *Apion* larvæ, that is, legless, but with the front segments somewhat enlarged below, and tubercled so as to aid in power of progression. The maggots lay also, as customary, somewhat curved together.

After careful examination of the Somersetshire specimens, especially of the very minute portion of the leg-joint called the *trochanter*, I am inclined to think that both *A. apricans* and *A. trifolii* were present.

The *trochanter* is an exceedingly small portion of the leg, placed immediately above the *femur*, or thigh, and intermediate between the *femur* and another small joint or portion called the *coxa*, which is affixed to the body of the beetle. The entire leg thus consists of *coxa; trochanter; femur*, or thigh; *tibia*, or shank; and *tarsus*, or foot. And *A. trifolii* may be distinguished from *A. apricans* (see also preceding page) "by having the anterior trochanters pitchy, and the four posterior trochanters black, whereas in the latter species they are all rufous." *

Prevention and Remedy.—Some leading points as to these may be found by observation of the broad scale infestations of the weevils themselves, independently of the maggot-attacks in the flower-heads.

In a record before me† an observation is given of the case of a field of Clover twice mown, when (in September) the part of the field near the stack had been lately attacked by a small black weevil, which advanced in a semicircle, leaving only the fibre. It was estimated that on some of the leaves there were as many as, or more than, a hundred weevils.

In another observation quoted in the same paper from the report

* See 'British Coleoptera,' vol. v. p. 149, by Canon Fowler.

† See Curtis's 'Farm Insects,' p. 477.

of M. Herpin, he mentions that his Clover was mown in full flower, and in about ten or twelve days, or rather less, after housing the Clover in the granary, a great quantity of *Apions* were perceived moving in all directions upon the wall of the building, and making their way towards the outside. The escape of these *Apions* continued for eight or ten days.*

These observations point to a good broadscale method of preventing or forestalling recurrence of attack by mowing the Clover before the flower-heads are sufficiently advanced to have become the nurseries of any great quantities of maggots. The *premature* and *partial* maturity of the florets in the flower-heads is one sign of presence of the maggots, and mowing on the first symptoms of this being noticed is one measure of prevention of a good proportion of coming mischief in the shape of development of beetles, which would lay their eggs either, as the case might be, in the flower-heads of the crop immediately following in summer, or after hibernation in those of the first crop of the following season.†

Any measures, such as cutting, or feeding the crop off early, before the heads have advanced to the condition at which they give shelter to the weevils for egg-laying, are obviously beneficial; and so likewise (where there is any reason to apprehend that infestation is likely to occur) is avoiding Clover crops remaining for more than two years in succession on the same ground.

Where the beetles are observed in the great numbers mentioned at p. 24, as leaving the stack and making a regular advance in a semicircle, destroying the Clover leafage in their march, it would be well worth while to experiment as to getting rid of them by the use of some of the various insecticides which are now available.

If circumstances allowed the space round the stack to be thoroughly secured by hurdles or otherwise, so that there was no *possibility* of the farm stock or ground game getting at the Clover, and there was no reasonable probability of poultry flying over the fence, the use of Paris-green would be exceedingly likely to be of service. The special use of the application would be that it might be presumed that (as in all other cases of application of this *poison*) the beetles would eat the sprayed leafage and *be killed*. Kerosine emulsion or soft-soap wash with paraffin mixed in it, or gas-lime applied as a dry dressing, would not act so certainly, because, although any of them might very likely protect the Clover plants on which they were thrown, they would have no effect in preventing the Apions taking flight from the stack in which they were developed. The *Apion apricans* have very powerful wings.

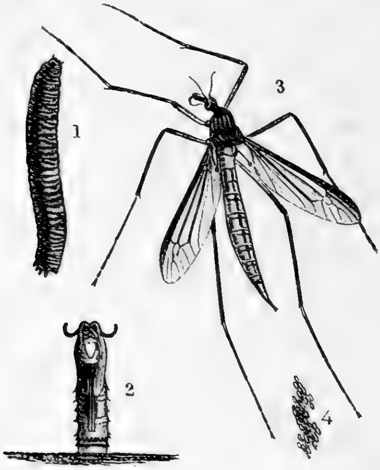
* See 'Extrait des Mémoires de la Soc. Roy. et Centrale d'Agric.' année 1842.

† This treatment of course is *not* applicable where the Clover is being grown for seed.

More observations of the above kinds of Clover flower-head attacks, with notes of measures found serviceable for their prevention, would be very acceptable for general farm use.

CORN AND GRASS.

Cabbage Daddy Longlegs. *Tipula oleracea*, Linn.
Spotted or Yellow Daddy Longlegs. *Tipula maculosa*, Hoffm.; *Pachyrhina maculosa*, Hoffm. and Meigen.*



TIPULA OLERACEA.—Fly, larva, and pupa standing upright in the ground as before escape of fly.

The "Leather Jacket" grubs, from which are produced the swarms of large, somewhat gnat-like, two-winged, and long-legged flies, commonly known as "Daddy Longlegs," or "Crane Flies," are only too well known by reason of the mischief which they cause every year at the roots of grass, of corn, and of many other kinds, both of field and garden crops, by gnawing them just below the surface of the ground, and thus more or less injuring the attacked plants, or destroying them them totally, as the case may be.

* In the following notes some of the observations refer to the presence of *Tipulæ* larvæ in pasture land, others to presence at Strawberry roots; but as they could not conveniently be separated, and as one of the observations refers their presence at both crops, I have inserted them under the heading "Corn and Grass" as the most well-known locality, but referring back to this heading from that of "Strawberry."

Of these *Tipulæ*, and their near allies the *Pachyrhinæ*, there are more than forty species to be found in this country; but of these there appear to be only three kinds of which the larvæ or maggots are looked on as year by year doing serious mischief as root pests. These are, respectively, the "Cabbage Daddy Longlegs" (*Tipula oleracea*); the "Marsh Daddy Longlegs" (*Tipula paludosa*), which is stated by Curtis to be so closely allied to the foregoing species that it is generally confounded with it, and is similar to it in habits and economy; and, thirdly, the "Spotted" or "Yellow" Daddy Longlegs (*Tipula* (*Pachyrhina*) *maculosa*), a much smaller kind, but also very mischievous.

With regard to the habits and means of prevention of the so-called Daddy Longlegs attacks, it appears as if everything had been recorded that could be needed for general service; * but I insert some further observations on the infestation, as in the past season I received some special contributions which enabled me to identify *T. oleracea* as doing much mischief in dry parts of hill pasture in North Britain, and the smaller kind, the spotted *Tipula maculosa*, as injurious in Strawberry beds; and also received some few additional remarks on remedial treatment.

The ashy or greyish general appearance of the Cabbage *Tipula* is well known; and the marsh kind, *T. paludosa*, for all practical purposes, may be described as very similar to it, excepting in the matter of the wings as well as the legs of the female being shorter in this species than in *T. oleracea*. The spotted kind, *T. maculosa*, is much smaller, the wings being only about an inch in expanse (whereas those of *oleracea* are from an inch and a half to two inches), and the colour is yellow spotted with black; the wings are yellowish, with yellow fore edge; and the long slender legs ochreous, with feet and tips of thighs and shanks black.

The only means, however, of knowing which kind it is of the above-mentioned species which is causing mischief is by *examination of the maggots*, and it is so very rarely that observations of attack on a large scale, with specimens accompanying, are available, that I give notes of mention of reports sent of presence of *T. oleracea* at grass roots of dry hill pastures, and of *T. maculosa* at Strawberry roots, as well as of both the above-mentioned species, also at Strawberry roots.†

* *Vide* references in General Index to preceding Series of Annual Reports, from 1877 to 1898 inclusive, by R. Newstead, F.E.S., with Preface by writer. Simpkin & Co., Stationer's Hall Court, E.C. Price 1s. 6d.

† I have continued use of the *popular* name of "Daddy Longlegs" for the flies, as, though certainly very trivial, it is better known generally than that of "Crane Fly."

Tipula maculosa is now known scientifically as *Pachyrhina maculosa*. The genus *Pachyrhina* is not very strictly limited; but the rust-yellow and sulphur yellow flies of this genus are distinguishable from the rust-yellow flies of the genus

The maggots of *T. oleracea* are about an inch in length when full-grown, cylindrical, legless, and about the thickness of a goose-quill, with little dark or black heads furnished with minute horns and strong jaws, which heads they can retract or protrude at pleasure.

The maggots of *T. maculosa* are very similar to the above in general appearance, excepting in being smaller, only about three-quarters of an inch in length, and the thickness of a large crow's-quill; and in both instances the colour is of some shade of earthy grey. But the two kinds may be distinguished (with the help of a magnifier) by the arrangement of tubercles, or fleshy protuberances, present at the *edge of the truncated tail segment.* In the case of *oleracea* the edge *above* is furnished with *four* fleshy tubercles, more or less pointed, and below are two more. In the case of *maculosa* the truncated tail is furnished *above* with *two spreading hooks and two short teeth between them*, and below with two tubercles. There are also two fleshy protuberances capable of being protruded or withdrawn.

The maggot of *oleracea* changes to the chrysalis in the earth, and presently, by means of transverse rows of spines, works itself through the surface of the ground, till about half the length is exposed (see figure, p. 26), and then by means of cracking open the horny covering the developed fly within makes its escape. This change may take place from the beginning of August (or even earlier) or during autumn, and some come out in spring. The larvæ, *vide* p. 29, may sometimes be found doing great mischief as early as the middle of March.

I am not aware of there being any difference worth mentioning in the life-history of *maculosa* either in maggot or chrysalis state from that of *oleracea.*

On July 7th the following communication was sent me by Mr. Robert Scott (shepherd), from Phaupknowe (? Newcastleton, R. S. O., Roxburghshire), N.B. It is very short, but still of a good deal of interest, from its observation of the great amount of damage done by the grubs to the dry parts of hill pastures; and also the benefit formerly received from crows (*anglice*, rooks) in keeping down the insect pest, which birds, however, were then being destroyed to a hurtful extent. Mr. Scott observed:—

"I take the liberty of enclosing to you in a box a sample of the caterpillar which is doing great damage to the dry parts of hill pasture on some farms in Liddesdale; it leaves the part quite bare. . . . The crows used to devour it greedily, but some parties in this district

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Tipula by some minute differences in the form of the head, of the first article of the antennæ, and of the second posterior cell of the wings, for which see descriptions by Meigen, Macquart, Schiner, &c. But for ordinary working purposes the flies are sufficiently distinguishable by their shining bright yellow colour and black spots.

have commenced a crusade against the crows and destroyed large numbers, so am afraid we will not get much help this year from them."—(J. S.)

I examined the sample sent carefully, and found no difference between it and the characteristic form of the larva of *T. oleracea*.

On May 30th the following communication was sent me by Mr. Denis Best, from Holt Castle, near Worcester, regarding damage caused to his young Strawberry plants by a grub of which he enclosed specimens, and which proved on examination to be larvæ of the Yellow or Spotted Daddy Longlegs (*T. maculosa*). Mr. Best remarked:—

"About two months ago I planted a piece of land, about five acres, with Stirling Castle Strawberry-runners. The weather since planting has been very much in their favour. I dressed the land with from twenty-five to thirty tons of stable manure per acre. About a fortnight ago I noticed that a good many of the young plants were dying off, and on closer inspection I found a small grub at the roots of the Strawberry-runners. If I cannot stop the roots being taken, I am afraid my plant of Strawberries on this piece of land will be destroyed. I am sending you with this one or two of the grubs."—(D. B.)

The specimens sent were from about one-fourth or three-eighths of an inch to rather over half an inch in length, and from the formation of the truncated tail segment, which was furnished with two spreading *hook*-like tubercles and two short teeth between them, appeared to be certainly larvæ of *T. maculosa*.

Early in March, by favour of Messrs. Laxton, of Bedford, a letter was forwarded to me from a Strawberry grower on a large scale in North Wales, whose name I do not give for obvious business reasons, requesting information as to how to prevent the ravages of a dark coloured caterpillar-like grub which was cutting the roots, and feeding in the hearts of the Strawberry plants.

On March 21st, according to my request, our inquirer forwarded to me samples of the "grubs or caterpillars," which he mentioned as having been causing great destruction in his Strawberry beds. These proved to be *Tipula* larvæ (Daddy Longlegs grubs) of various sizes, some of them apparently of *T. oleracea*, the Cabbage kind, and some with power of protruding tubercles at the side of the truncated caudal extremity were *T. maculosa*. Mr. —— mentioned:—

"My Strawberries are infested with the caterpillars now" [that is, at time of writing, March 21st, which is a point worth noting for practical consideration.—E. A. O.]. "Their action is to cut the roots of the plants and eat into the heart of them. When they have quite killed a plant, the caterpillars appear to go off to another plant, which is alive. It is rather strange that the three years' old plants are those chiefly affected. We see little damage done to the plants one and two years' old. . . . Last summer we observed great numbers of this grub in the corn fields in this neighbourhood."

On May 6th, after some further communication, my correspondent wrote me the following remarks, which it will be seen embody in them some useful suggestions as to use of nitrate of soda. After some preliminary observations he wrote :—

"Having 35,000 of the three-year old Strawberry plants to deal with this year, I have come to the conclusion that the best plan is to try the nitrate of soda.

"I have been in communication with Dr. Bernard Dyer, for I wished to know how much nitrate I could use without injuring the plants. He has advised me to use $\frac{3}{4}$ oz. the square yard, putting it in equal quantities round the crowns of the plants. This is at the rate of 2 cwt. to the acre, and we are using it in powder. The first shower of rain will carry it all down. . . . To apply in a state of solution would be great labour and rather dangerous, for those employed in the work could not so well ascertain what amount they were really giving to each plant. . . . I propose next autumn, when these three-year old plants are taken up, sowing salt at the rate of 12 cwt. to the acre, and then planting the ground next spring. Salt at the rate of 12 cwt. to the acre will, as we know, kill any weed and Couch-grass, surely it will also kill the grub unless they go down away from it."

Observations were given of attack *in summer* to a very destructive extent by *white grubs*, apparently *Otiorhynchus* or weevil larvæ, presumably of one of the kinds which are frequently injurious to garden fruit crops by feeding at the roots in grub state, and at the leaves and soft shoots in beetle condition; but these notes I have carefully separated from those referring to the Daddy Longlegs grubs.

My correspondent promised me a report as to effect of the application of the nitrate of soda, and on November 3rd was good enough to send me the following information :—

"The nitrate of soda was applied during the months of April and May to about 35,000 Strawberry plants; this was carried out in accordance with instructions kindly given to me by Dr. Bernard Dyer. An examination of the roots of the plants in June and July showed that there were but few grubs of the Crane Fly present, but immense numbers of the beetle grubs. The application of the nitrate of soda did not in the slightest degree check the ravages of the grub. The crop was a failure, owing to the fact that the plants were almost separated from the ground, the grub having cut nearly all the small roots, and eaten into the heart of the plants as well. I marked plots of plants which did not receive any nitrate of soda. There was no difference between the plants which received it and those which did not.

"I noticed also that there was no extra leaf growth in the plants receiving the nitrate of soda. This was rather strange, because nitrate of soda increases the leaf growth very much. I can only account for it in this way,—after the application of the nitrate of soda we had very heavy falls of rain several times, and I think the nitrate of soda was washed away before the plants had derived any benefit. Our soil here is very light and porous, and I have several times seen nitrate of soda applied to our corn crops, and *in a very wet time no good whatever was derived from it*." * Here my correspondent made some observations on the likelihood of sulphate of ammonia being more serviceable on such a porous soil on account of being less soluble than the nitrate of soda.

The above report, though by no means satisfactory in the point of view hoped for (and consequently adding to the losses of my correspondent, instead of lessening them), is valuable, and deserves careful attention in several of its details. Firstly, it did *not* induce a vigorous growth, which, where circumstances allow, is *the great reason for application* of nitrate of soda. Secondly, though only a few of the Daddy Longlegs grubs were found present in June and July, it is by no means certain that we owed this absence to the nitrate. We have no *evidence* either way; that is, the Daddy Longlegs grubs, to kill which it was applied in April and May, may have been killed, or they may (by June and July) have changed to fly state and taken flight. Thirdly, the application had done no harm to the white grubs, distinguished especially as beetle grubs, which, from the specimens sent me, I had found to be weevil, and apparently one of the very common kinds of *Otiorhynchus* grubs, which are very injurious at plant roots, and in this instance a bad attack observed to occur in summer.

The cause of the failure is attributed, so far as non-stimulating the plant growth, to great rainfall, and probably this is perfectly correct; and the observation that similar failure of effects had been noticed when applied to corn crops in a very wet time confirms the view, and is valuable in itself. Therefore, as giving the reason of failure of what is usually a trustworthy remedy, I give my correspondent's notes *in extenso*, as valuable both for crop and fruit growers.

Prevention and Remedies.—These have been entered on in my previous Annual Reports so very fully that I only now repeat some of the main points or general principles of prevention.

With corn and grass crops a fertilizing application which will keep up the strength of the plants that are not hopelessly injured is what is most needed, and if at the same time the application is one injurious or obnoxious to the larva it is all the better.

* The italics are mine, to draw attention to observation of great fall of rain neutralizing the effect of the nitrate of soda, as this is important.

Applications that have been found to answer as a dressing, or in bringing crops through bad attack are,—guano; guano and salt mixed at the rate of 4 cwt. per acre; also guano 1½ cwt., salt 2 cwt., kainite and superphosphate each 1 cwt. per acre.

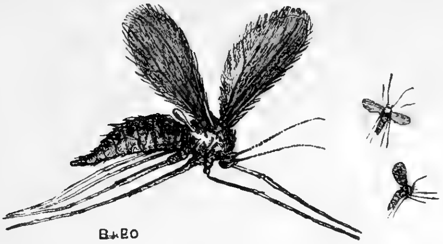
Nitrate of soda acts well, as being a rapid fertilizer, and also obnoxious to the grub; and has been reported as having thoroughly good results, given at the rate of 1 cwt. the acre, to Barley when just above ground, on badly grub-infested land. A mixture of nitrate of soda and salt has proved useful, applied at the rate of rather more than 3 cwt. of salt and rather less than 1 cwt. of nitrate per acre, after rolling with a Cambridge roller, and harrowing. But in whatever way applied, nitrate of soda, or any other good fertilizer which will act at once, if melted and driven down by rain, has been found to have a good effect, unless (see p. 31) the rainfall is so great as to wash the fertilizer away.

Salt alone, applied as a remedial dressing where the grub was present, has failed in many cases to do good. In special experiments it has been found that, applied at a rate which killed the plants, salt had no effect on the grubs, except to drive them down for a time to a depth beyond its influence. But as a *preventive* dressing to ley-land before ploughing up, it has been found highly serviceable. Salt at the rate of from 5 to 12 cwt. applied before breaking up, or lime and salt mixed, would probably do much good. A heavy dressing of salt which would kill Grass, Couch-grass, or surface herbage before ploughing in would do no harm in this way, and destroy much shelter for this, as well as other insect vermin; and any of the methods of treatment or chemical applications which are known to be of use as preventives of Wireworm attack would also be of service.

Gas-lime applied in caustic state so as to act first as a destroyer of plant life and insect vermin on the surface of the land, and (after proper exposure to the air) as a safe and serviceable manure, is doubly useful. This may be given at a rate of two tons per acre, and should be applied by being spread evenly on grass-land before breaking up, or on stubble, or other land as required, and left exposed to the air for at least three or four weeks before being ploughed in. Thus a portion of the constituents, which at first do good by their poisonous nature, become changed by the action of the air to sulphate of lime, or gypsum, as manure serviceable on many soils.

Mechanical measures such as compress the ground and so prevent the larvæ "travelling" are of use; and so are the opposite methods of treatment, such as hoeing, harrowing, &c., which act by throwing the earth open and disturbing the grubs and throwing them open to bird attack. But what is commonly most needed is preventive treatment to the ground applied well beforehand.

"**Hessian Fly.**" *Cecidomyia destructor*, Say.



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

In the past season when, from the conditions of the weather during many weeks of the summer being very favourable to appearance of Hessian Fly, many observations of it might have been expected if the infestation was still present to any important extent in this country, I only received one report of its presence. This was sent me at the beginning of August, from Barton, near Marlborough, by Mr. D. D. Gibb, for many years a contributor to my Annual Reports, and who has especially helped me by notes of observation of this and other corn pests.

On August 4th I received a communication from Mr. Gibb, in which, after mentioning that he forwarded me some pieces of Wheat straw, which he considered showed the presence of insect pests to some considerable extent on the Wiltshire Downs, he further remarked:—

"My attention was called to part of a large field of Wheat, some fifty-eight acres, which as a whole was a satisfactory crop, say five quarters per acre. But in those parts where the soil was thinnest—near the chalk—the straw was very much broken and twisted over the ground. One of the very first straws examined yesterday, when the cutting was in operation, contained the "flax-seed" of Hessian Fly. On further examination to-day these do not seem to be so numerous over the field as at first expected. Wheat-bulb Fly has done most mischief, unless Hessian Fly attacked very early last autumn close to the root. In pulling, the empty pupa-cases fall out, after which it is difficult, without very careful examination, to distinguish between the two."

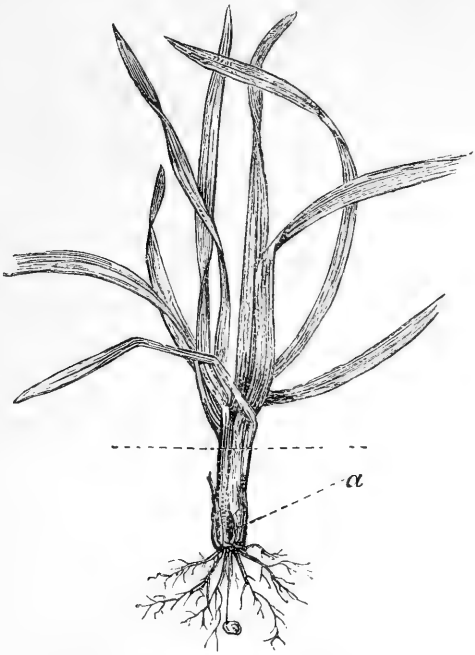
Together with Mr. Gibb's communication, he forwarded me a sample of the Hessian Fly infestation in the chrysalis or pupal state, in which it is commonly observed on straw in summer (see fig. 2, p. 36); but it will be noticed that Mr. Gibb also alludes to possibility of attack having occurred to the young autumn Wheat. This sometimes takes place to a destructive extent, but is much less observable than that to the summer straw, and I am not able to recall an instance of this form of attack having been reported in this country. Therefore, though now after the experience of thirteen years there appears no reason to fear that we shall be troubled by Hessian Fly as one of the regular crop pests, I have alluded to the infestation again to bring information up to date regarding, firstly, method of winter infestation and its effect on the appearance of the attacked plants; secondly, the use according to the most modern views of the process beneath the larva, or maggot, known as the "breast-bone," or "anchor-process," more scientifically as the "sternal spatule," of which I gave a figure from life in my Annual Report for 1886, p. 15, and repeat it now at p. 37; and thirdly, the *enormously important point* that in the paper by Prof. Osborn (published under the direction of the Entomologist of the Department of Agriculture of the United States, and forming Bulletin No. 16, New Series, of the publications of that department) it is noted that burning the stubble is one of the standard measures of prevention which is most generally applicable in the United States of America, and also attention is drawn to *the desirability of burning chaff and screenings after threshing.* These matters are entered on in detail in the following pages.

The ordinary points of the attack are well known; but it may just be mentioned again that the *Cecidomyia destructor*, or Hessian Fly, is a very small two-winged gnat-like fly, hardly as much as one-tenth of an inch in length; the male one-third shorter than the female; the wings clothed with black hairs or scales; and the general appearance of the body very dark. When magnified, it will be found to be varied with pink, or red, or yellowish brown, and black, the black being more present in the male than the female.* The bright red colour which the abdomen of the newly-developed female appears to the unassisted eye is very noticeable to trained observers, and it is of considerable interest to watch the gradual alterations of colour.

The method of attack is for the fly to lay her reddish eggs in the long furrows of the upper surface of the leaves of the Wheat or Barley or Rye. On the hatching of the maggot, which it is stated may take place in about four days, it then, in its first and *locomotive* state, moves down the leaf, and along within the leaf-sheath, until it reaches a position near the base of the culm, but necessarily differing in position, and in its effect on the plant, according to whether it occurs to the young autumn Wheat, or when the plant is in its summer state with its jointed stem.

* For long and minutely detailed technical description of male and female *Cecidomyia destructor*, Say, see account by Mr. R. H. Meade (from living specimens), published in the 'Entomologist' for July, 1887; and also given at pp. 15 and 16 of my Annual Report for 1887 by permission of Mr. Meade, and of Mr. Newman, proprietor of the 'Entomologist.'—(E. A. O.)

The accompanying figure shows a young Wheat plant infested by Hessian Fly, the position of the pupa below the ground being shown



Plant of young Wheat showing position of Hessian Fly maggot at *a*. (After Prof. Webster.)

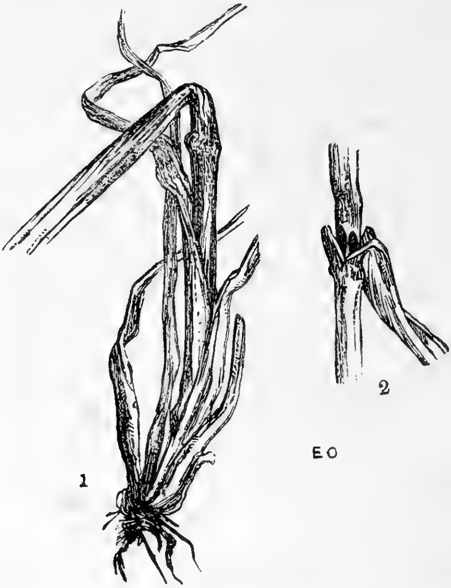
at *a*. In a circular by Prof. Webster, of Lafayette, Indiana, U.S.A., from which this figure is copied, giving his experiences of three years' special observation of Hessian Fly maggot attack on young Wheat, and from which I quote in my Annual Report for 1887, he mentions that he considered that the winter presence might be detected by peculiarities of the growth and colour of the infested plant. He pointed out regarding the condition of the plant figured, "The plant itself has not tillered; the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf, and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infested plant from one not injured."—(F. M. W.)

This is the state of things where the plant has been attacked before it tillers; but (as has been remarked) in case the plant has tillered, the Hessian Fly maggot may only attack one, or some of the tillered shoots, and the rest of the tillers may develop into healthy stalks, and give a crop.

The progress and effect of this larval infestation are thus described by Prof. Osborn, U.S.A.,* in his recent most valuable condensation of information up to date on Hessian Fly attack:—

"In autumn the eggs are laid upon the early appearing leaves, and the passage of the larvæ down the sheath carries them down to or below the surface of the ground, often very near to the root itself. Here their presence causes more or less swelling of the base of leaf and culm, scarcely enough to be counted a gall formation, but the immediate effect seems to be a stimulus at the point of attack."

The above describes the effect of infestation on autumn or winter Wheat before the plant has developed; in the case of presence on the spring Wheat when the stalk has grown, it is very much more noticeable. In this state of growth the maggot makes its way similarly



Attacked Barley-stem: 1, bent down; 2, showing "flax-seeds."

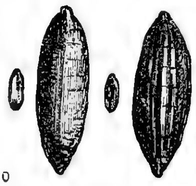
down the leaves, but there under the sheathing-leaf it takes a position commonly above the first or second knot, and ends its *locomotive* life. It remains fixed at one spot, feeding on the juices of the stem, which thus becomes weakened at the place of suction, until it bends, or "elbows" down, as shown in the figure, drawn from life by myself.

By this—that is, by the "elbowing," or bending down of the straw at an acute angle—the Hessian Fly infestation may be easily distinguished from all of our other corn stem infestations, and also the

* See 'Hessian Fly in the United States,' by Prof. Herbert Osborn, p. 27; Bulletin No. 16, New Series, U.S. Dept. of Agriculture, Washington, 1898.

losses from the mere injury to the yield are increased. This diminution of produce may be more or less according to circumstances, but damage to the heads, from their fallen position, and inconveniences in harvesting from the confused state of the crop, add much to troubles.

Fig. 2, p. 36, shows the next stage of condition. After remaining as above from a period variously estimated as from about twenty to twenty-eight days, the white legless maggot contracts, the outer skin hardens, and it changes to a somewhat flat brown chrysalis-case, so exceedingly like a rather small and narrow flax-seed in size and also in shape and colour, that the name of "flax-seed" is commonly given to the *puparium*, or chrysalis-case (see figure). Within this case the maggot goes through its changes to the perfect fly, or gnat-midge. This may take place so that the whole time of development from egg to fly state is only forty-eight days; but the time occupied may vary much, some of the flies may come out the same autumn, and others, threshed out, or kept in the straw, or preserved artificially for investigation, may very likely not hatch out until May or later in the following year. My own first specimen (which I conjecture to be the first of which the appearance has been definitely recorded in Britain) made its appearance on September 8th, 1886, from infested Barley straw collected not earlier than the preceding 27th of July, and from its bright red colour, by which attention was drawn to it, must have been very recently developed.



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

Returning now to the condition of the maggot, or larva, after the external change of its appearance to the "flax-seed" state, there are some points regarding its structure brought forward by Prof. Osborn (see p. 16 of his work, previously quoted), which are of considerable interest. *Beneath* the maggot, whilst still in its general white state within its newly formed brown coating, and very near the head, is a chitinous or horny appendage, known as the "breast-bone," or anchor. This process consists of a short stem fixed at one end to the larva, and free at the other extremity, which points forward. The fixed end is placed between the first and second segments. The shape of the free end is conveyed by the accompanying figure, which was taken by myself from life, and gives a very fair idea of the stem of the process, which is about the same width for half its length, and then gradually swells out, and is terminated by two conical prolongations, forming together a strong fork.

Breast-bone of *C. destructor*, greatly magnified.

Regarding the precise use of this process, called now the "sternal spatule," or "breast-bone," there has been much speculation, and it is now considered by Prof. Osborn that the opinion which is best supported is that the "spatule" is used by the larva to reverse its position in the *puparium*, so that, whereas the larva rests at first with its head downward and toward the roots of the plant, it rests after turning with its head upward and toward the upper part of the plant.—(H. O.) On this matter I do not feel qualified to offer an opinion; but, reasoning by analogy, my views have leaned towards it possibly having uses as a scraper, or digger, as in microscopic investigation of the larvæ of one of our Willow *Cecidomyiæ* it certainly appeared to me that I found minute amount of woody matter attached to the free head of the "breast-bone," giving the idea of this differently shaped free end being of service in making its way in the harder material. This, however, is merely a conjecture of my own.

Prevention and Remedies.—As the attack (as a practical evil) seems to have almost entirely passed away from among us, there appears no occasion to enter on preventive measures, which are as a general thing quite uncalled for, but of which the details are thoroughly well known and accessible if needed.

Amongst these, however, there is one method of treatment which in this country we apply for the most part so customarily in the regular process of our agricultural arrangements, that it may be well to allude to it, and this is *the date of sowing of our autumn Wheat.* In U.S.A. practice, where "fall" or autumn Wheat sowing runs earlier than with us, it has been especially recommended that sowing should not take place until after the 20th of September in the northern States; the date of course varies in different countries according to differences in temperature, but commonly with us Wheat is not sown until danger of infestation from Hessian Fly is past.

In ordinary natural circumstances the life of the flies is very short, and considered not to extend beyond a few days, and if in this short time there are no plants at hand for egg deposit on which the maggots can feed, this is an enormously important measure of prevention. It not only is the saving of the crop, which might wholly or partially have perished in young state, but it lessens the attacks of the year by preventing occurrence of the winter generation.

One other highly important point which should always be borne in mind by those who find their crops of Wheat or Barley suffering under attack of Hessian Fly in summer is that after threshing *all the infested chaff* or light screenings should be burnt or soaked, or in some way thoroughly destroyed.

In the valuable Bulletin on Hessian Fly by Prof. Herbert Osborn, published by the United States Department of Agriculture (referred to *ante*), attention is strongly drawn at p. 42 to the great importance of destroying the *puparia*, or chrysalis-cases, of an infested crop by burning the stubbles, or by destroying the chaff in which these "flax-seeds" are to be found after threshing.

From circumstances of climate, custom, and also from straw being in this country cut so low that much of the infestation is carried off the field with it, the plan of burning the stubbles is not so applicable with us as in the United States. Something, however, might be done in case of straw being noticed to be badly infested towards preventing flax-seeds left in the short stubble developing to fly, by "skimming," and then dragging the rubbish together and burning it.

Burning the chaff and infested light screenings is a very important point. The light screenings, which are chiefly of dust, small weed seeds, and the like, being thrown down together by the threshing-machines, there is little difficulty or expense in gathering them up and destroying them. If it is troublesome to burn this infested material, it may be thoroughly mixed in wet manure. This would not certainly destroy the weed seeds, but it would make an end of the *puparia*.

Objections have been raised (theoretically) to this treatment, that thus we destroy the parasites which *might* be in the Hessian Fly puparia, or chrysalis-cases, and which *might* develop into little parasite flies, and *might* fly to the Wheat and Barley fields, and there destroy the Hessian Fly in its embryo state. But this benefit is problematical, and if we burn the light screenings and the contents, we kill the Hessian Fly in its young state thoroughly and undoubtedly, whilst our hand is on it, without waiting for the involved considerations of letting *it* go to do certain harm, and the parasites to do an uncertain amount of good.

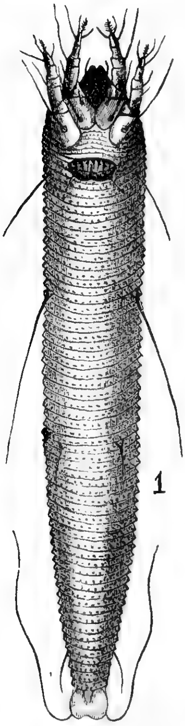
At one time the matter of preservation of infested screenings was so strongly *endeavoured* to be upheld here in some quarters (though never, so far as I am aware, by those with good practical knowledge of the bearing of the subject), that the late Prof. Riley, Entomologist of the U.S.A. Dept. of Agriculture, wrote me especially on the subject, saying that he had no doubt that, whatever might be the case in America, *in this country the right course was to destroy the puparia.*

Now, in the work of Prof. Osborn, which is an admirable digest of information up to date, we have the recommendation (as one of the standard remedies most generally applicable) to destroy the *puparia* when and where we can by burning the stubble, or burning chaff and infested screenings; and personally I would most earnestly advise all concerned in this country not to listen to any unproved theories on the subject, but just to destroy the pest when it is in their power.

During the past season little communication regarding presence of our common corn crop attacks was sent, excepting some very local observations on Corn Sawfly and Wheat-bulb Maggot. Injury from Corn Sawfly is caused by the maggot feeding within the stem, and finally gnawing it nearly through in a ring from the inside about ground-level, the straw consequently falling. The maggot changes to fly in the remaining part of the stem, and therefore "skimming" and and collecting the stubble and burning it before the fiy comes out in the following early summer is a sure remedy. Wheat-bulb Maggot does not call for further notice; and "Wireworm" is noticed under "Hops," as some good remedial treatment was suggested regarding its attack to this crop. A note on carnivorous Wireworms is also given.

CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



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PHYTOPTUS RIBIS, greatly magnified; natural length of female 0·23 mm. (By permission, after Dr. A. Nalepa.) Black Currant twig with three buds affected by Mite Galls, and one bud unaffected.

Careful experiment has still been continued on all points which appeared likely to throw light on means of prevention of the Black Currant Mite Gall disease, which for so long has been a yearly cause of great loss to growers on a large scale. So far as I am aware, however, none of the chemical applications which have been tried have given satisfactory results by destroying the infestation without injury to the plant growth ; but as these observations will, I believe, be fully reported on in detail, I am only entering here on some parallel experiments carried on in connection with observations at the Woburn Experimental Fruit Farm, Ridgmont, Beds, which I have the pleasure of taking some small part in, and am permitted to mention here.

The object of the investigation was to ascertain whether the attack was propagated in part by Currant Gall Mites, that is, *Phytoptus ribis*, harbouring in the earth at the roots or round the bases of the stems of the Currant bushes.

We know that the mite is to be found in the Black Currant buds during a great part of the year. From about the middle of July, when the young buds of the season are forming, the swollen galled growths may be found to be commencing, and even at that early date the mite (or *Acarus*) may be found in all stages from egg onwards within; as time goes on the growth of the galled buds progresses, till they are only too conspicuous as green mis-shapen balls of abortive leaves, or, when partially opened, as perishing rosette-like masses, crowded within (as long as the vegetable matter is sufficiently soft to give support to the parasites) with legions of the minute cylindrical four-legged mites, of which an enormously magnified figure is given at p. 40. About the beginning of June, if any of the old galls are still sufficiently alive to furnish food, the *Phytopti* may be found in them, and they are also to be found (both as old and young mites) between the base of the leafstalk and the buds at the ends of the young shoots.*

So far as appears, we are perfectly acquainted with the history of the mite on the plants in their above-ground life ; but very careful investigation was needed to discover whether spread of infestation took place from mites sheltered in the earth at the base of the stems.

For this purpose it was arranged that Black Currant plants taken from the Woburn grounds, where the infestation was present, should be quite cut down to the ground and removed, some with the earth adhering, but no other way treated excepting in being quite cut down ; and some others similarly cut down, and also washed in a mixture of

* For precise history of *P. ribis* through the year, see "Recent Investigations of the Currant Bud Mite (*Phytoptus ribis*)," by R. Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, Lecturer on Economic Entomology for the Cheshire County Council, pp. 5–7. Reprinted from 'The British Naturalist' for June, 1894. Price 3d.

methylated spirit and water. It appeared that, in the case of these plants being removed to gardens *certainly* known neither to have or to have had infestation present for many years, if the mites and the mite-galls appeared on the growth from the removed roots, the *Phytopti must have travelled with the plants*, and thus we should gain knowledge of a locality where we might attack the pests.

My own garden at St. Albans was especially well adapted for experiment, as to my knowledge from personal observation there had been no presence of mite-galls on the bushes for the whole period which I had known it, namely, since September in the year 1887, and I was very glad to take part in the parallel series of observations.

Accordingly, on November 1st, 1898, a small consignment of six plants of Black Naples, and six of Baldwin's Black Currants, was forwarded to me from the Woburn Experimental Fruit Farm. This dozen of plants had simply been cut down, but nothing else had been done to them; they arrived in due course, and were immediately planted in my garden in a favourable position for growth.

Another consignment, also of six plants of Black Naples and six of Baldwin's Black Currants, was sent me two days afterwards. These had likewise been cut down, but had undergone the further treatment of being steeped (both roots and short remaining portions of stems) for two hours in equal volumes of methylated spirit and water. These also were planted promptly; with the approval of Mr. L. Castle, Manager of the Experimental Fruit Farm, of the localities chosen, and especially of the two consignments of plants being completely isolated.

Of the twelve plants which had merely been transplanted after being cut down one plant died; of the twelve which had been subjected to the severe treatment of being steeped for two hours in spirit and water, in addition to being cut down, four died. The remainder made growth naturally, and on examination taken early in November, 1899, a few days over a year from the date of planting, those which had merely been removed averaged in number of shoots about eight each, the length of the shoots being about eighteen inches. The plants which had been washed averaged about five in number in shoots, the length of the shoots being about fifteen inches. From the above points it was obvious that the washing was by no means good for the general health of the plants, and it may be further added that, although the simply moved plants appeared excellently healthy, the others were by no means in equally good condition. This simply refers to conditions of health, not to any considerations of mite presence or mite-gall growth, from which all of the plants on the most careful examination, as well as minute investigation of interior of the bud, proved through the whole course of observations to be entirely free.

On October 18th, Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, under whose microscopic superintendence the *Phytoptus* investigations have been carried on, wrote me regarding results of his examination of the condition of my experimental bushes as follows :—

"I find no trace of *Phytoptus* in any of the buds from the four lots of bushes in your garden at Torrington. Moreover, the buds appear perfectly healthy, and considering the treatment of the plants they have made good growths."—(R. N.)

On a subsequent (also microscopic) examination of buds taken from the above-mentioned plots of Black Currants on Nov. 12th, Mr. Newstead reported that, with regard to the "Baldwins" and Black Naples which had been merely closely cut down and removed from the Ridgmont grounds to my garden at St. Albans, he found both kinds perfectly free from *Phytoptus* infestation in the buds, and with no external signs of the diseased growth, and also that the plants appeared to be in perfect health.

With regard to the others which had been cut down, but likewise steeped for two hours in equal parts of methylated spirit and water, Mr. Newstead found no signs of mites about them, and the buds were perfectly healthy. The plants (as detailed above) were less vigorous than those which had merely been transplanted, but still those which had survived it had made fair growth.

In the same report, Mr. Newstead mentioned that he found the isolated plots of Black Currants which had, like those in my own garden, been removed from the experimental ground at Ridgmont, where the *Phytoptus* infestation was present, to the garden of Mr. Spencer Pickering, F.R.S. (Director of the Woburn Experimental Fruit Farm), at Harpenden, where *no infestation was present*, gave equally satisfactory results. Mr. Newstead reported :—

"I do not find a trace of *Phytopti* in them. The buds on the shoots forwarded to me were perfectly healthy, and judging from these I should say the plants were even more vigorous than those in your garden at St. Albans."—(R. N.)

Thus we found that in all the instances under observation there was *no conveyance of infestation in the earth at the roots of the Currants.* Although they had been taken up from infested ground, yet where they were planted in gardens known to be clean from the pest, the plants were found on the most stringent examination to be quite free of all *Phytoptus* presence on their shoots and buds subsequently growing from the transplanted roots.

To complete the experiment, observations were taken as to what might occur to Black Currant removed to the Ridgmont Experimental Grounds, but *not to isolated gardens known to be free from Phytoptus* *presence.* In this case the clean plants, which were transplanted to the fruit farm at Ridgmont, where there is infestation, *did not escape the pest.* A number of buds were found by Mr. Newstead to be *badly* infested.

Some Black Currant plants imported from the Continent (presumed to be mite-proof), which have been growing for a year in close contact with diseased bushes at Newton Farm, Newton, Glasgow, N.B., under the observation of Mr. John Speer, up to date of report on Dec. 5th showed no external signs of disease. But we need another season's observation to test condition definitely.

Amongst various points suggested by the above observations, one very important practical point is the confirmation it gives to the utter uselessness of expecting to grow large areas of Black Currants without infestation of the Gall Mite. This point has repeatedly been noticed, and by some of our soundest observers, to be the case; but it adds further force to the arguments to find that plants placed in non-infested localities preserved the shoots from the ground perfectly clean, yet if placed, as above mentioned, in or at a given distance * from an infested area became infested by the mite-tenanted galls.

To a certain degree the experiments may save trouble, as, for instance, in attempts made to counteract the infestation by cutting down bushes to get a new clean growth, and in dressing the ground round the base of the Currant stems with chemical applications in winter to kill mites. The plan of cutting down the stems has been one of those tried for some time back, though never, I believe, with success for more than possibly a year or two, and (so far as I am aware) the cut-down plants have not been moved from the infested plots, which would quite account for the failure of the experiment.

In what way the mites are conveyed, or convey themselves, as in the above instance, over a more or less extensive area we do not know. Where bushes stand close together, and also in the fruit-gathering season, workers are going to and fro amongst them, it is obvious that mites may easily spread, or be spread, from the bushes, especially at the time when the mites are migrating (see p. 41) from old galled buds to shelter at the base of those which in the middle of summer are just beginning to form.

But where transit has to be made above or on clear ground, the method of operation is still unknown. The plumage of birds might of course afford one method of carriage, and also where the galled buds have grown to the stage at which in drying up they open like a loosely made rosette the dried abortive leaves might be blown by the wind with the mites adhering. It can hardly be supposed that the mites

* The actual distance at which the plants were separated from the infested area was about fifty yards.

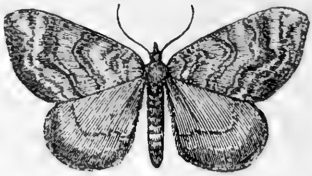
would travel along the ground, as their peculiar long, narrow, cylindrical shape, with their two pairs of legs appended at one extremity, appears entirely to unfit them for this kind of progression.

We still, so far as *preventive* measures are concerned, remain where we were, and breaking off the galled buds and destroying them appears to be about the only *practically* available method; but the observations detailed above show still more plainly than before that where Black Currants are grown in large areas (or even in large plots) near to each other, it must be with an appreciable addition of cost at so much per measure for clearing galls, if the plants are to be kept even moderately free.

Another observation which we made to some small extent was with regard to whether Currant plants which were known never, or never during the years under which they have been under observation, to be infested in their own place of growth would remain "mite-free" when transplanted to an infested ground. With this view some seedling plants from the plot in my own garden, which, as mentioned at p. 42, was noticeably free from *Phytoptus* presence, were removed to the Ridgmont grounds, and there *all of them became infested.* Also some plants moved from the garden of Mr. Spencer Pickering, at Harpenden, which is clean from infestation, became infested when moved to the Ridgmont grounds.

The life-history of this attack and the various attempts to cope with it, and everything that we are acquainted with bearing on the infestation, has been entered on in my Annual Reports from that for 1885, inclusive, up to date, with the exception of those for 1886, 1890, 1895, and 1896, and especially entered on at great length, with notes of the first records of observation of it in England in my Annual Report for 1897, pp. 141–158; therefore I only now give the above additional observations, and this more particularly as I believe that at no distant date a detailed account will be prepared of the careful experiments which have been carried on at the Experimental Fruit Farm at Ridgmont.

"Spinach Moth."* *Cidaria dotata*, Linn.



CIDARIA DOTATA (from Newman's 'British Moths,' p. 193).

On July 4th I was favoured by Mr. Rouse Orlebar, of Hinwick Lodge, Wellingborough, with an excellent specimen of the moth, figured above, sometimes known as the "Spinach Moth" (scientifically *Cidaria dotata*, Linn.), as a sample of an infestation which had attacked his Red Currant trees to a considerable extent this year.

The moth is about an inch and three-eighths in the spread of the fore wings, which are of an ochreous yellow ground colour, with transverse lines, all sharply angled, but of various widths and various depths of colour; the two lowest near the base of the wing point, and slender; the next line distinct; the two next slender and indistinct; the next (that is, the sixth transverse line from the base of the wing) very distinct, with the inner margin shaded off into the colour of the wing, and the outer margin sharply defined and accompanied by a paler line. At the tip of the wing at the front angle is an oblique very short streak dividing the fore (costal) margin from the hinder margin, the latter being the palest. The fringe is pale, and (typically) is described as having eight brown spots; my specimen had seven spots on the fringe of one fore wing, and six on that of the other. The hind wings, which are very pale and slightly yellower towards the hinder margin, have a pale fringe with four or five dark spots. The head and body are pale yellow.

The caterpillars are yellowish and, as described by Dr. Ernst Hofmann,† "are rather more than an inch long, bluish green, and smallest at the fore part. Dorsal line darker green, with yellowish segmental divisions. On each side of the dorsal line, whitish, the line containing the spiracles yellow, but often absent. Spiracles ringed with clear brown, not projecting. Beneath grey green, with a yellowish central line. Head as wide as the first segment, entirely yellow; neck shield not distinguishable; tail flap small yellowish. Warts very

* The name of Spinach Moth appears somewhat misleading, but as it is an accepted appellation I have given it. Several of this genus of moths are known as "Carpet" Moths, with a word descriptive of some characteristic prefixed.

† See 'Raupen der Gross Schmetterlinge Europas,' von Prof. Dr. Ernst Hofmann, vol. (Text) p. 234. Stuttgart, 1893.

small, of the colour of the body. Claw feet clear yellow brown; sucker feet and caudal feet yellow, the latter with rather strong horizontal prolongations."

The short account of appearance and method of feeding of the caterpillar, quoted from the description of Mr. Wormald by Edw. Newman,* is as follows:—"It rests on the posterior claspers, with the head and the legs contracted; it is smooth, without lumps or warts, long, slender, and attenuated towards the head; the colour is pale yellowish green, with the dorsal line darker, and the subdorsal lines pale yellow and indistinct. It feeds at night on the Black Currant (*Ribes nigrum*). Its habit is very sluggish, remaining for several days on one twig, and feeding on all the leaves within its reach before changing its position. The eggs were laid on the 3rd of August, and hatched in the second week of April, and the caterpillar was full-fed at the beginning of June, when it spun a slight cocoon on the surface of the ground."

It is also mentioned (at p. 193, referred to in note), "Mr. Doubleday informs me that at Epping this caterpillar always feeds on the Red Currant."

On applying to Mr. Orlebar for any further notes of observation of the attack which he might be good enough to favour me with, he kindly added the following somewhat important remarks:—

"I did not notice the attack as becoming serious until about June 1st, and the caterpillar was fully fed about the 10th. I notice that Edw. Newman does not give his own account of the caterpillar, but quotes Mr. Wormald, who says that it feeds on the Black Currant; but it has not done so here, the Red Currant only being attacked. He also says it is a night feeder. This I did not notice, but I should think it probable, as its position by day was usually upon the stalk of the leaf, where it was resting with its body slightly arched. It hung by a thread when disturbed. . . . He" (Mr. Wormald), "however, states that 'it spun a slight cocoon on the surface of the ground,' which is contrary to what I observed here, where it invariably made a very slight though very strong web, not less than three feet from the ground, on the stem of the bush itself, and generally at the junction of the young wood and the old. This difference seems to me of some importance, as of course different methods of destroying the chrysalis would be necessary if the pest became at all general. The moth appeared on the wing about the end of June."—(R. O.)

The slight differences in description of the appearance of the caterpillar—as, for instance, the English observation of it as "smooth, without warts or lumps," and the German as "warts, very small, of the colour of the body"—do not seem to me very important, as higher

* See 'British Moths,' p. 193.

magnifying powers may have been used for the more detailed description; but the locality of the cocoon certainly is, and to the two, above given, Dr. Hofmann adds a third. He mentions that the larva feeds on *Asperula galioides* and *Galium verum* and other kinds of *Galium*,* and that transformation takes place in a slight web, between the leaves or blossoms of the food-plants. Conjecturally, if we had more observations we should find that locality of pupation varied with special circumstances, or with the nature of the food-plant.

Prevention and Remedy. — The eggs are stated to be laid in August, and to hatch in the following April; but unless by the application of kerosine emulsion, which will sometimes destroy vitality in eggs, it scarcely appears possible to get rid of the pest in the egg state.

The only remedial measures which seem practicable are clearing the web-cocoons containing the caterpillar or chrysalis. This might be done by hand-picking from the Currant stems, or by clearing any leaves or other parts of the attacked plants (Currant or otherwise), which may have been spun up. If the cocoons are found on the surface of the ground these might usually be very easily got rid of by just skimming them off with a spade run flat half an inch or so beneath them and destroying them.

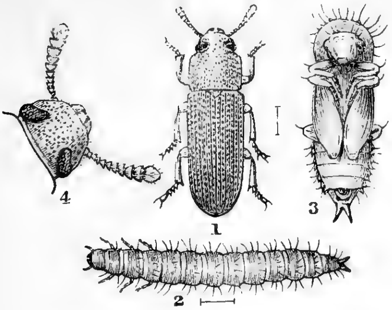
In the case of the American species, *Cidaria diversilineata*, Hübn., of which the caterpillars feed on Vine leaves, the infestation is double-brooded. The second brood passes the winter in caterpillar state, coming out in spring to feed, and very soon after going through the changes to the moth condition.† The remedies advised for this attack where the "larvæ are sufficiently numerous to prove troublesome" are syringing with Paris-green in water, or with hellebore in water; but these remedies would need great care in application if admissible at all on crops for domestic use so far advanced as Currant fruit during the month of June.

* The different species of *Galium* are for the most part known with us by the name of Bedstraw; *G. verum* as the "Yellow Bedstraw." A popular name of several species of *Asperula* is Woodruff, also with some prefix; but *A. galioides* is not given as an English plant in 'Sowerby's British Botany.'

† See 'Insects Injurious to Fruits,' by Dr. W. Saunders, Director of the Government Experimental Farms in Canada, p. 270.

FLOUR AND GRAIN BEETLES.

Rust-red Flour Beetle. *Tribolium ferrugineum*, Fab.
Confused Flour Beetle. *Tribolium confusum*, Duv.



Tribolium ferrugineum.—1, beetle; 2, larva; 3, pupa—magnified, and with lines showing natural length; 4, head with antennæ, much magnified.

The Rust-red Flour Beetle, figured above, is sometimes described as being a cosmopolitan species, but it should more accurately be said to be present in all parts of the world which are warm enough to suit its habits. In this country it nas been noticed at a good many localities, extending in England as far northwards as Northumberland, and in Scotland in the Forth district, and is recorded as occurring in flour; also as being often found in bakers' shops, and occasionally taken under the bark of old trees, and it is said to be common. It was not, however, until the past season that it was brought under my notice, not as a home pest, but as an infestation to which cargoes of of flour transmitted to us from various parts of the world were seriously liable.

The insects appear to be by no means strictly limited in their diet (and consequently infestation may spread from quarters where it might not have been expected); but, without minute specification here, it attacks grain in the form of cereals, and other seeds, articles containing farinaceous matters, and very especially flour and meal.

The various cases of infestation which I had the opportunity of examining were in Wheat flour; and in one of these, transmitted direct from one of the most southerly ports of the United States, I found the infestation so numerously present that I had excellent opportunity of studying it in its various stages, and also of noticing the discoloured and injured state of the flour, which is a characteristic of its presence where this occurs to anything like the extent commonly understood by the word "*infestation.*"

The following short notes of some of the chief characteristic points of the larva and pupa are taken from 'The Coleoptera of the British Islands,' by the Rev. Canon Fowler, vol. v. p. 20:—

"The larva is linear and parallel, slightly narrowed towards apex, of a rufo-ferruginous colour above and paler below, the segments are furnished on each side with setæ, and the anal segment is very small and terminates in two short pointed appendages.

"The pupa is much longer than broad, and is set with rather short setæ, the plates at the sides are strongly bifid, and the cerci are comparatively long, and sharply pointed at apex."

In the sample of infested U.S.A. Wheat-flour which was sent me for examination, I found about fifty of the *T. ferrugineum* beetles and a good supply of larvæ. These larvæ, or maggots, were of various sizes, from about three-sixteenths to two-eighths of an inch in length, or, in one instance, rather more when the maggot was quite fully extended in walking. The width approximately one-eighth of the length. The surface shiny, with some hairs; the shape cylindrical, parallel-sided for most of the length, but lessening towards the tail extremity, which was terminated by two pointed processes (see figure, p. 49). The colour ochreous; when seen magnified, the segments pale at the edges, above broadly banded transversely with ochreous, the cross-bands being darkest on the segments nearest the tip of the tail, the under side of the larva pale or white. The fore part of the head ochreous, mandibles darker, and brown at their pointed tips; antennæ in length about half the transverse width of the head. The six claw-feet white or very pale, slender, and of sufficient length to allow the larva to walk easily, and at a fair rate of progression.

The figure of the pupa (p. 49) and the description above are perhaps enough for practical purposes; but I observed that the striæ on the *elytra* (wing-cases) folded beneath the body were very noticeable with a two-inch focus object-glass, as also the two pointed processes at the tip of the abdomen. The length was about one-sixth of an inch.

The beetles are of rusty-red or reddish yellow-brown in colour, elongate, parallel-sided, rather depressed; head and thorax thickly punctured, head comparatively large but narrower than thorax; the latter broader than long; the antennæ rusty-red, "*with the three last joints forming a club*," * terminal joint paler; wings ample, and were

* The three last joints of the antennæ forming a club, and likewise the head *not* being expanded beyond the eyes at the side, are characteristics by which this species, that is, *T. ferrugineum*, Fab. (*T. castaneum*, Herbst; *Stene ferrugineum*, Kirby) may be especially distinguished from *T. confusum*, Duval. This species occurs in England, but is considered not to be as common with us as *ferrugineum*, which it closely resembles in colour, form, size, habits, and life-history; but in the United States of America this species (*T. confusum*) is stated from the time of its first recognition in the country as a distinct species to have been "reported as injurious in nearly every State and Territory in the Union."

easily observable by separating the abdomen of a dead specimen and slightly crushing it in water, so that the wings expanded and floated; wing-cases with punctured striæ; legs ferruginous. Length from slightly under up to one-sixth on an inch.

The infested Wheat-flour in the tubes sent me was noticeably *not* of a pure white, but of a greyish tint, and when the tubes were placed on a bed of perfectly good white flour, the discoloration of that in the tubes was very clearly appreciable. This discoloration is one very important proof of presence of infestation, as mentioned in the following extract from the heading to observations on "Flour Beetles," by Mr. F. H. Chittenden, p. 112 of publication referred to below*:—

"Their eggs are often deposited in the flour in the mills, and these and the larvæ they produce being minute and pale in colour readily escape notice; but after the flour has been barreled or placed in bags and left unopened for any length of time, the adult beetles make their appearance, and in due course the flour is ruined, for when the insects have time to propagate they soon convert the flour into a grey useless mass. A part of the annoyance to purchaser, dealer, and manufacturer is due to the fact that the insects are highly offensive, a few specimens being sufficient to impart a disagreeable and persistent odour to the infested substance."—(F. H. C.)

I had not sufficient material to give opportunity of thorough observation of the matter of unpleasantness of smell, but the grey colour was very observable, also the injured state of the flour.

The geographical distribution of this species is of considerable importance as to possibilities of its transmission in cargoes of grain or flour, and the following observations on this head are taken from some of the notices on 'Insect Life,' published by the Division of Entomology of the U.S. Department of Agriculture, Washington.

In "Nos. 7 and 8," vol. iii., 1891, at p. 333, is a note of damage caused by this infestation in company with other kinds being forwarded by the U.S. Consul, Maracaibo, Venezuela (South America) to the Entomologist of the U.S.A. Department of Agriculture. In this case the damage was to ripe Indian corn after it was shelled and stored, and in the official reply it was stated that the four kinds sent were "cosmopolitan beetles, and infest stored grain all the world over."

In No. 3, vol. vi., Feb. 1894, Prof. C. V. Riley, in his report on "The Insects occurring in the Foreign Exhibits of the World's Columbian Exposition," mentioned that "*Tribolium ferrugineum*, Fab., occurred in the cereal exhibits of most of the countries of tropical and subtropical America, Asia, and Africa. . . . Common also in Europe, and well distributed over this country" [*i.e.* United States of

* 'The Principal Household Insects of the United States,' Bulletin No. 4, New Series, U.S. Dept. of Agriculture, Washington, 1896.

America, E. A. O.], "where it is sometimes called 'Flour Weevil,' and is often injurious to grain, meal, flour, and a great variety of other products" (C. V. R.).

In No. 4, vol. vii., of the above-named work, in a paper by Mr. F. H. Chittenden, it is mentioned at p. 329 that the writer had "seen specimens of the *Tribolium ferrugineum* from North Carolina, South Carolina, Georgia, Florida, Louisiana, Texas, Nebraska, Oklahoma, and California" (F. H. C.). Many other localities are given, but the above observations are quite enough to show that whether in cargoes of grain or flour, there is every possibility of this pest, *T. ferrugineum*, being shipped from almost any warm locality.

Tribolium confusum, Duv.—In the above observations I have tried to limit them to *T. ferrugineum*, but for business purposes some notice should be taken of *Tribolium confusum*, Duv., as this species is recorded as "being almost an exact counterpart of the Rust-red Flour Beetle (*T. ferrugineum*)," to closely resemble it "in colour, form, and size," and also in habits and life-history. This species differs from the "Rust-red" Flour Beetle in the antennæ, or horns, being less completely club-shaped—that is, they are gradually thickened to the extremity; in *T. ferrugineum* the *last three joints* forming a kind of club, in *confusum* the *last five or six joints* are wider than the preceding. Also this species has a broader head, and the *sides of the head are expanded at the sides beyond the eyes.*

Of this species it is said*:—"*Tribulium confusum*, Duv., derives its name from the fact that the species has been generally confused with *ferrugineum*. Prior to the appearance of Duval's description, published in 1868, both species were known under the latter name, and until within the year" [1895—E. A. O.] "the same has been the case in America. As a consequence, our literature, mostly treating of *ferrugineum*, may refer to either species." Without again going over details of geographical distribution, it may be mentioned that it occurs in England, France, Germany, and Italy, and is very generally distributed in the world, notably America; it is stated in 1896 that this species "has been reported as injurious in nearly every State and Territory in the Union."

Of this kind, it is stated:—"The tiny clear white eggs are attached to some convenient surface in the cracks or on the sides of the bag, barrel, or other receptacle in which the infested substance is contained. These hatch into minute larvæ, which feed for a period depending on the temperature, and then transform to naked white pupæ, which in due time change to beetles, which copulate soon after transformation, and another generation enters upon its life round. In this manner

* See 'Insect Life,' vol. vii., No. 4, p. 329, U.S. Department of Agriculture, Washington, U.S.A.

several broods are generated in the course of a year. From observations conducted by the writer" [Mr. F. H. Chittenden—E. A. O.], "it has been learned that this insect is capable in an exceptionally high temperature of undergoing its entire round of existence from egg to imago in thirty-six days. The minimum period of incubation was not ascertained, but it may be assumed as about six days. This, with six days for the pupal period, gives twenty-four days as the shortest developmental period of the larva. In cooler weather these periods last two or three times as long. In well-heated buildings in a latitude like that of Washington we thus have the possibility of at least four generations in a year." *

Looking at the circumstance that it is very recently that the two above-named species of beetle have been considered to be other than all of one kind, and that still they are recorded as closely resembling each other in colour, size, form, habits, and life-history, their preventive treatment may be laid down safely to be similar.

Prevention and Remedy.—A very important point in household or store treatment is scrupulously cleaning all barrels, tubs, lockers, bins, or other wooden depositories in which flour or grain that has been found to be infested by Flour Beetles may have been kept. A thorough "scrubbing" applied with *scalding hot water* by a good hard scrubbing-brush of the make with a few rows of longer bristles at one end, so that all chinks and crannies could be well cleared out, would probably be very effective. If soft-soap and a little mineral oil of any kind could be used in solution in the scalding water without danger of tainting the flour which might subsequently be placed in the cask or other wooden receptacle,—this of course would be a great additional safety.

The transmission of attack in connection with infested bags or packages is a most fertile source of mischief. Independently of bags *containing* flour, those that are returned empty convey the infestation, whether of the special kinds of Flour Beetles under consideration, or the "Granary Weevils," or the "Mediterranean Mill Moth" in legions; and it is not only in traffic to and fro, but where these infested bags are used *without proper purification* as ship packing material (technically, I believe, known as "dunnage"), that enormous mischief is done.

I have no record of this precise form of trouble having arisen with regard to the *Tribolium* beetles; but with regard to the *Calandra*, or Granary Weevils, observation has been put in my hands of the weevils being so swarming in the dunnage as to fall down the men's backs in the packing operations. This might be completely obviated, whether with the *Tribolium* or other infestation, by placing

* See 'Household Insects,' referred to, *ante*, at p. 51.

the bags in a raised temperature such as would kill the insects. Baking the bags would do all that is needed on the scale of moderate amount of material; but on a large scale, or where dry heat may be thought likely to hurt the material, the application of steam, as used to destroy "Flour Moth," may be used for disinfection, as recommended by the U.S.A. Department of Agriculture. Obviously the *method* of application varies with circumstances; in large scale workings a steam-tight chamber, in which bags, machinery, or anything requiring disinfecting might be placed, would be a means of doing excellent work.

In the details given me of operations in Ontario (Canada), under an Order of Council of the Local Government on appearance of the "Mediterranean Flour Moth" (*Ephestia kuhniella*) in that country in 1889, it was mentioned in a report from the "Canadian Steam Mills," especially suffering under the outbreak:—"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 every machine, and even the millstones and iron rollers, were submitted to purification by steam, and the measures taken "resulted in a complete eradication of the pest" from the premises.*

It is not for me to suppose that I can judge what arrangements are desirable at shipping ports, but it certainly *seems* that, where steam power is at hand, such a chamber which could be hired by anyone needing its services, would be an excellent adjunct; and very certainly a stricter supervision by owners' representatives, and a little more knowledge of the habits and appearance of the flour and grain pests would be a means of saving enormous losses.†

Preventive measures are especially desirable in case of flour infestation as *remedial* attempts are costly in any case, and may be injurious to the material. A rise of temperature, for instance, of from 120° to 150° F. will (it is stated) kill most insects, but a greater heat will injure the flour, and even this may be prejudicial.

Sieving removes the beetles and larger maggots (at a cost of so much per stone), but the eggs and small young maggots will probably pass through the meshes in numbers together with the flour.

* See Bulletin 1 and Appendix to Bulletin 1 on the 'Flour Moth,' issued by the Ontario Dept. of Agriculture, prepared by P. H. Bryce, Sec., quoted in my Thirteenth and Fifteenth Annual Reports, under the heading of "Flour Moth."

† There is a pamphlet of twenty-four pages entitled 'Some Insects Injurious to Stored Grain,' by F. H. Chittenden, Assistant Entomologist to the Department of Agriculture, Washington, U.S.A. (published by the Department), which cannot be too highly recommended to the notice of all connected with trade in flour or grain, whether on land or sea. It contains short, plain, practical information on about twenty kinds of flour and grain infestations, with numerous good figures, and likewise working notes of practicable common-sense remedial and preventive measures.

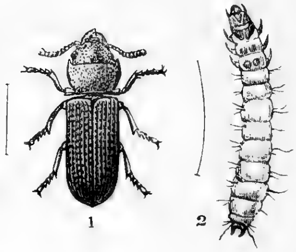
Fumigation by bisulphide of carbon is efficacious, but is dangerous both with regard to its great inflammability, and also *may* be prejudicial to the operators; but there are some broadscale methods of treatment which would save a deal of loss if they *were* more attended to, and which apply equally to the Rust-red Flour Beetles, and other kinds also infesting flour.

One of these is the "inspection, quarantining, and disinfection of infested or suspected grain, bags, and machinery before storage" (see 'Insects Injurious to Stored Grain,' referred to in note, p. 54). From enquiries sent to myself for some years past regarding cargoes of flour or grain received at various of our British or Irish ports from various parts of the world, I should say that attention to the first of the above items ("inspection") as soon as possible on arrival, and by some one interested in the matter, and *able to distinguish one kind of insect presence from another*, would often save a deal of subsequent trouble, also risk of loss from continuance of damage in the material, and likewise of spread of the infestation. In the case of the *Tribolium ferrugineum* beetles under consideration, they have ample wings, and could distribute themselves to anything liable to their infestation near at hand. "Quarantining" would be a preservative from this especial form of trouble; but with regard to the consignees or owners of the material, a *skilled* inspection of conditions of stores, sheds, or goods on the docks adjacent to where the barrels, bags, or other packages were to be placed would be highly desirable.

In a communication sent me a few years back regarding not much under a hundred barrels of flour, which consequently on beetle presence had to be emptied, sieved, and repacked, we found on investigation at the docks that a quantity of material next to which the flour was stored was swarming with the same insects. As the amount of beetles in my correspondent's eighty-five barrels was only sufficient to make sieving necessary to avoid a breach of regulations, it was presumable that the infestation arose from the "swarms" sheltered close by. The conditions of samples of infested cargoes on which I am consulted show, in some instances (taken together with the observations furnished), *beyond all doubt*, that the flour, or grain, was shipped in an infested state, or was packed on shipboard with material so infested with the "pest" (whatever it might be) on the "dunnage," &c., that the cause of the mishief *demonstrably* was present in the commencement of the transmission of the cargo. In other instances, for want of examination *on arrival* (before the consignment had been exposed to possibility of home infestation), there was hardly any way of arriving at certainty when the mischief began, consequently on whose shoulders the pecuniary loss should rest; and in cases of this kind, where referred after lapse of weeks to skilled investigation, the trouble of absolutely making sure how the matter stands is something enormous.

Here we come to the point at which the amount of technical knowledge procurable in an hour or two's study from such a trustworthy and plainly worded publication as that referred to in note, p. 54, and investigations based on the knowledge would save constant loss and trouble. In my papers I have reports on condition of cargoes from stevedores, weighers, and samplers, whose porters landed cargo, and others too numerous to specify, but it is to a very slight extent that we get from such sources reliable evidence as to the amount or nature of insect presence. But the representative of those interested could very easily see to all that is needed, and amongst other points distinguish by five minutes' study between the injurious infestations and one which, when occurring in infested flour cargoes, there appears constantly so much more reason to believe is at least to some degree beneficial, that I give some notes on it in the following paper.

"**Cadelle**"; **Bread Beetle** (German). *Tenebrioides* (*Trogosita*) *mauritanicus*, L.



Tenebrioides mauritanicus.—1, beetle; 2, larva: magnified, with lines showing natural length.

The name of "Cadelle" appears to be now given to *T. mauritanicus*, both in beetle and larval state; but in the early days of its observation this name was more especially bestowed upon the larva. The infestation is to be found in this country in bakers' shops, granaries, &c., but it is considered to be an imported species, and whether or not it was originally introduced to us from Africa, it has long been abundant in that country, as well as in America, and in a great part of Europe.

Its scientific appellation, which was in former days *Trogosita mauritanica*, has more recently been exchanged, for technical entomological reasons, to that of *Tenebrioides mauritanicus*, and recent investigations of its habits, on which opinions formerly greatly differed (or on which the observations were only imperfect), have now proved that both in larval and in beetle condition it is to some degree carnivorous; that is, it *feeds on insects*, as well as on grain and on some other vegetable products.

The special mischief caused by this infestation with which it is credited from the time of Curtis onwards, is the damage which is caused by the larvæ feeding on stored grain. It is also stated that the larvæ are peculiarly destructive from their habit of eating the *outside of the grains*, and passing from one grain to another, and thus injuring more than they consume.

In the Bulletin on 'Insects Injurious to Stored Grain' (1897), referred to previously, which, so far as I am aware, gives the most recent information on the subject, is (at pp. 18, 19) the following valuable observation, which I quote verbatim, as in it Mr. Chittenden, Assistant Entomologist to the Department of Agriculture of the United States of America, records from his own personal observation the fact of *T. mauritanicus* being both in larval and pupal state a grain feeder; and afterwards also mentions definitely that in both conditions they are likewise insectivorous. Mr. Chittenden remarks as follows:—

"The statements of some of the earlier writers that this species is granivorous have been discredited by later authors. It has been experimentally proven by the writer, however, that the insect lives both in the larval and adult conditions upon grain; and furthermore, that were the insect more prolific it would become a source of much damage to seed stock, from its habit of devouring the embryo, or germ, going from kernel to kernel, and destroying for germinating purposes many more seeds than it consumes. Both larvæ and beetles serve a good purpose by attacking and destroying whatever other grain insects they happen to encounter."—(F. H. C.)

The infestation is recorded as being found in cereals, nuts, and almonds, besides other material, including bread, as noted by Dr. Taschenberg,* whence the German name of "Bread Beetle." It is also noted as being sometimes found in dead trees; and the beetle is observed by Taschenberg to be found at large under bark, or in decayed wood, where more or less it must have lived on prey, "wo sie mehr, oder weneger vom Raube leben durften."

But though the decidedly insectivorous propensities of this infestation have long been known, I have not been able to find any precise description of the method of their operations (nor have I seen it myself in the case of the beetle). In the past season, however, in the course of some observations which I was making on the Rust-red Flour Beetles (*Tribolium ferrugineum*), I had occasion to keep a number of the beetles and larvæ in a sample of the Wheat-flour in which they had been imported from New Orleans, and with these were two larvæ of

* 'Praktische Insektenkunde,' pt. ii. pp. 16–18.

Tenebrioides mauritanicus, commonly known as the "Cadelle." On examining the collection carefully, I found several of the Flour Beetle maggots showing signs of attack, and having apparently been killed by biting and suction of their bodies; and besides these more or less injured specimens, others of the Flour Beetle maggots were lying in pieces in the flour. In this instance there were no other kinds of insects present excepting those mentioned above, so that it appeared impossible that the attack could have been from any other cause than from the deliberate onslaughts (so to call them) of the Cadelle.

This larva, or maggot, is whitish, fleshy, nearly three-quarters of an inch in length, and about a twelfth of an inch in breadth, cylindrical, but somewhat largest in the segments near the tail extremity, and slightly hairy, the hairs long at the sides. The head narrower than the body, hard, dark brown or black, with short antennæ, and is also furnished with a pair of curved, sharp, horny jaws. The segment behind the head is marked above by a transverse brown band, often divided longitudinally by a narrow white line, and the two following segments are each marked above by two brown spots. The tail segment is dark brown, and is terminated by two brown horny conical spines, and by these brown spines forming a kind of fork, and by these and by the brown spots on the second and third segment from the head the maggot is easily recognizable. The three pairs of claw feet on the segments next the head are long enough to be of use in walking.

The pupæ are about half an inch in length, white, and with the forming limbs folded beneath; but I have had no specimens to describe from. A good figure is given at p. 18 of Mr. Chittenden's Bulletin, referred to, *ante*, p. 54.

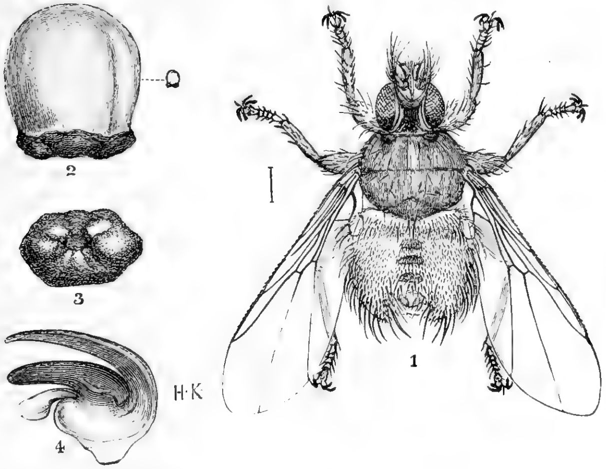
The beetle is elongate-oblong, depressed, from about a quarter to rather more than a third of an inch in length, blackish, or sometimes pitchy red in colour. Head broad, but narrower than fore body; antennæ (horns) slightly pubescent, and with a not very distinctly marked club; mouth with two strong bifid jaws meeting in front. Thorax broadest in front, with the anterior angles produced, narrowed behind. Wing-cases broader than the thorax, and nearly three times as long, with delicately punctured striæ; wings moderately ample; legs rather short.

In regard to measures of prevention, these are to be less called for in the case of this infestation than with most of our other grain infestations, as there appears to be only one brood yearly. Also, when found in flour or meal (as we are not aware of either the beetle or its maggot feeding on these materials), it appears probable that if present they are doing us more good than harm in these localities.

As grain pests, the case is different; and the ordinary remedies, such as disinfecting bags in which infested grain has been conveyed, clearing out all places of shelter in refuse, fumigation of bins, thick white-washing to stop up all chinks in walls, and the like remedies, would all be serviceable in getting rid of the infestation in stores, or bakeries, or similar places where it may occur with us.

GROUSE.

Grouse Fly. *Ornithomyia avicularia*, Linn.



ORNITHOMYIA AVICULARIA.—1, Grouse Fly, magnified, with line showing natural length; 2, puparium, magnified and natural size; 3, end view, magnified; 4, claw, magnified.

Ornithmyia avicularia, figured above, is a small two-winged fly from two and a half to three lines in length, tough or leathery, somewhat elliptical in shape, and flattened, of variable colour, but usually of some shade of brown, and is found on birds; with us it is chiefly noticed on Grouse (*Lagopus scoticus*), whence its usually adopted name of "Grouse Fly."

I am not aware of it ever being injurious or seriously troublesome to birds by its presence amongst their feathers, as the nearly allied "Horse Forest Fly" (*Hippobosca equina*) is amongst the hair of Horses and Cattle, or the "Deer Forest Fly" (*Lipoptera cervi*) amongst the hair of Deer; but observations are occasionally sent me regarding it being noticed in connection with Grouse; and the genus *Ornithomyia*, of which up at least to 1888, the species *avicularia* appears to have been the only kind recorded as present in Britain, is of some interest from the peculiar structure of its claws. (See frontispiece.)

The Grouse Fly, as well as the Horse and the Deer Forest Flies, belongs to the division of the *Pupipara*, or pupa-bearing flies, characterised by their young not being produced in egg or larval state, but as *pupæ*. That is, the larval growth takes place inside the abdomen of the female, and it is produced, or, popularly speaking, laid, as a pupa, or just at the time when the change from the larval (or maggot) state to that of the pupa is taking place. Previous to the exclusion, the abdomen of the mother fly is noticeably much enlarged; and contrariwise, when the pupa has been deposited, the shrunken state of the abdomen is strikingly observable.

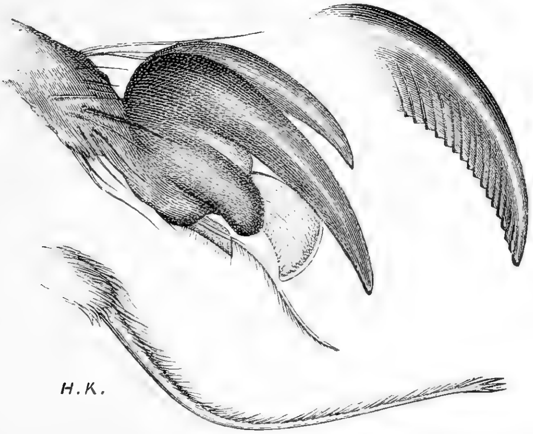
In the case of the *puparium* figured at p. 59, the mother Grouse Fly was sent me on August 13th from Swansfield House, Alnwick, by Mr. E. G. Wheler, with the observation, "I am sending you a Grouse Fly, which I hope may reach you alive. It is evidently a female with pupa." On receipt of the specimen, I forwarded it undisturbed to a friend for microscopic setting, who remarked in reply:—"As I noticed its abdomen was very small and collapsed, I concluded it had deposited its puparium, and on examining the pieces of hay in the tube I found it attached to a small fragment; so have taken it out, and send it on to you. . . . It is at present very transparent, so I imagine the fly will not emerge for some time yet."

From the deposit taking place after the female had been secured in the tube, I was thus enabled to secure a specimen of the puparium for figuring that without doubt belonged to the Grouse Fly; but the pupa having apparently been killed by the journey, I had no opportunity of observing its changes after birth. In the very early condition in which it is figured (see p. 59), the somewhat mamillated or deeply corrugated posterior extremity of the puparium very much resembles one of the figures given by Réaumur * of the puparium of *Hippobosca equina* before it had assumed the wholly brown colour which it gains shortly after birth, and also the smooth surface and merely emarginate end of the posterior extremity of the mature puparium.

The fly (*O. avicularia*) much resembles the Horse Forest Fly in general appearance, but is smaller, not being more than a quarter of an inch in length; somewhat elliptical in shape, flattened, and tough, or leathery. The colour variable, being sometimes of a yellow horn colour, sometimes the upper side is almost brown, and sometimes the light parts are of a bright green. (In my own specimens the green tint was not present.) The head round, flattened, with two knife-

* 'Histoire des Insectes,' par M. de Réaumur, tom. vi. pl. 48, fig. 12, mém. 14. Paris. MDCCXLII.

shaped organs projecting from the mouth; antennæ very short, ciliated; eyes large; *ocelli three*, on the top of the head. Upper side of thorax depressed; suture noticeable; scutellum commonly with hairs only at the hinder edge. Abdomen obconical, hairy, more or less emarginate. Wings longer than the abdomen, of a brownish yellow tint (for neuration, see figure, p. 59). Legs hairy, each foot furnished with two claws, and *each claw tripartite*. By this formation of foot, the *Ornithomyia* is easily distinguishable from the more commonly observed *Hippobosca equina*, in which (see plate) each of the two claws with which each foot is furnished is only *two-parted*. One of these divisions being (as figured below) large, strong, curved, and pointed at the



Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata*, showing parallel grooves and saw-edge—all much magnified.

extremity; the other thicker, and much shorter and rounded at the extremity, forming a kind of thumb-like appendage to the chief division of the claws.

In *Ornithomyia* (see plate) each foot is similarly furnished with *two claws*, but each of the claws (see also figure, p. 59) is *three-parted*. Of the two larger divisions, one is long, narrow, and tapering gradually to the pointed extremity; another of the divisions is almost as long, but is thicker and almost of the same width throughout to its bluntly rounded tip. The third division, which originates at the enlarged base of the main divisions, may be described as being formed for about half its length of a narrow stem, and then rapidly enlarged to about four times its previous width into a somewhat trumpet-shaped extremity (see plate).

The subordinate and very elaborate minutiæ of the foot apparatus, which, in the main points (though not quite precisely in the size and form of some of the details), correspond with those of the foot of

H. equina, will be much better conveyed by comparison of the two plates than by description. The pads, or *pulvilli*, and the very long hairy bristle (*empodium*),* are present in each case; but from differences in microscopic setting the details are in some respects more clearly displayed in the figure of *Ornithomyia*. In regard to the pads, of which *both* are well shown in *Ornithomyia*, although from an unavoidable circumstance one only is given in *Hippobosca*, and also the bristly *empodium*, I believe there can be no doubt; but besides these, both in the Grouse and the Horse Forest Fly, there is a sort of flat flap placed apparently above and between the two claws, with lines radiating from the centre to each side,—this is largest in the Forest Fly's foot,—and there appears to be clearly connected with a bulb-like process (see plates). Probably dipterists may be perfectly well acquainted with this organ, but, as I have not been able to find any description which seems to correspond with it, I merely give the figures.†

The Grouse Fly (*Ornithomyia avicularia*, Linn.) belongs, as above mentioned, to the family *Hippoboscidæ*, of the great division of *Pupipara*, of which some are known as Leathery Flies (*Coriacea*, Meig.), and some (popularly with us) as Forest Flies. This genus may be distinguished by the following characteristics from the others of the *Hippoboscidæ*. It possesses *three ocelli*; it has on each foot two claws, of which *each claw* is *three-parted*; and also the wings, which are of the *ordinary proportion of width*, are *longer than the abdomen*.

Thus Ornithomyia *is distinguishable:—*

From *Hippobosca* (parasitical on horses and cattle), which has *no ocelli*.

From *Olfersia* (parasitical on birds), which has also *no ocelli*.

From *Stenopteryx* (parasitical on swallows), of which the wings are very narrow, being scarcely more in width than one-sixth of their length, and are pointed at the extremity.

From *Oxypterum* (parasitical on swallows), which much resembles *Stenopteryx*, but has *no ocelli*.

From *Lipoptera* (= *Lipoptena*) (parasitical on deer), which has *two-parted claws*.

From *Melophagus* (parasitical on sheep), which is wingless, and has *no ocelli*.

From *Braula* (parasitical on bees), a very small kind, which is wingless and also eyeless, and without *perceptible ocelli*.

* "Pulvilli . . . are membranous pads, one beneath each tarsal claw; . . . the *empodium* often exists between the two *pulvilli* of each tarsus. The empodia may be bristle-like, or tapering, or membranous, resembling the pulvilli in form."—'Manual for Study of Insects,' p. 420, chap. xix. (Diptera), by John Henry and Anna Botsford Comstrock. Ithaca, N.Y., U.S.A.

† In my Nineteenth Annual Report I have entered in much detail on the life-history and peculiarities of structure of various species of *Hippoboscidæ*, with very full references to the writers cited, pp. 95–118.

In the above short attempt at differentiation, I have adopted the characteristics given by Dr. J. Rudolph Schiner, in his 'Fauna Austriaca: Die Fliegen (Diptera)' ii. Theil, pp. 644–650, as being the best guide which I am personally acquainted with, through the perplexities of synonyms of many previous writers.

The following short observation of habits of the Grouse Fly was kindly sent me by Dr. W. Somerville, Professor of Agriculture of Cambridge University:—"I am glad to see you have taken note of the Grouse Fly, a creature that has often attracted my attention. In warm weather in August, when one lays Grouse out to cool (as, for instance, during lunch), one has frequently the chance of seeing the fly. It generally runs, but occasionally flies a foot or two, and it is astonishing how rapidly it can disappear amongst the feathers of a bird. It is also very apt to run up one's sleeve, a not very desirable characteristic."

Besides the usually observed habitat amongst the feathers of the Grouse, I have a note from Mr. O. E. Janson, F.E.S., with which he favoured me on September 21st in the past season, that, "Strange to say, I have just obtained a very good specimen, which we found alive in a box with a specimen of the Long-eared Owl (*Asio otus*), which had been sent from the north of Scotland."

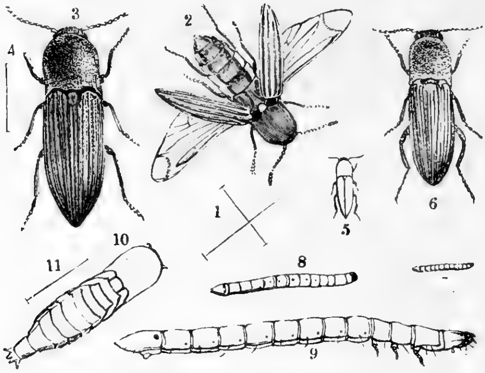
A much more remarkable locality was given in the case of a specimen sent to myself on September 18th from Swansfield House, Alnwick, by Mr. E. G. Wheler, which was found on a Lamb. In this instance I conjecture that from some cause or other the fly had dropped from a Grouse to the ground, or possibly developed from a fallen puparium (as it was a very perfect specimen), and had sheltered in the Lamb's wool as being temporarily at hand.

How far the presence of *Ornithomyia* on birds may be a source of annoyance to them does not appear to be recorded. From the presence of transverse slanting ridges on the side of the claw (see plate), which we know in the case of the Horse Forest Fly to have an excessive, and most unpleasant power of holding firmly to the hair when opposed to an opposite portion of the claw, it may be presumed the Grouse Fly can similarly hold firmly to the feathers. But unless the "host" was greatly injured by the presence of the infestation, or we had observations of it on the birds in a state of captivity, we do not seem to have means of following up the point. Also it may certainly be believed that if any irritation was caused by the presence of the fly, that the Grouse or other bird would not fail with beak or claw very promptly to dislodge the cause of annoyance.

I have pleasure in acknowledging all the figures in illustration of this paper as being by the skilled pencil of Mr. Horace Knight, and drawn for me from English specimens furnished by myself.—E. A. O.

HOPS.

CLICK BEETLES AND WIREWORMS—Small Brown Click Beetle, *Agriotes obscurus*, Linn. Pasture Click Beetle, *Agriotes sputator*, Linn. Carnivorous Wireworm Beetle, *Athous rhombeus*, Ol.



Agriotes sp.: 1 and 2, *Agriotes lineatus;* 3 and 4, *A. obscurus;* 5 and 6, *A. sputator*, natural size and magnified; 7, Wireworm of *A. sputator?*; 8 and 9, Wireworm of *A. lineatus*, natural size and magnified; 10, back of pupa of Wireworm, magnified. Lines show natural length.

During the past season more than ordinary amount of enquiry was sent me regarding treatment for prevention of Wireworm attack, together with requests for leaflets on the subject. The applications began about May 20th, and continued for the most part daily, and ranging sometimes up to as many as five or six a day for about a month, occasional applications continuing for some weeks or longer. Amongst these communications, however, little information was given that has not previously been fully entered on,* with the exception of an easy and successful method of trapping "Click Beetles," the parents of the Wireworm, and thus much lessening the amount of propagation; also a good observation of a kind of Wireworm which has been recorded as of carnivorous habits, being captured in the act of gnawing its way through the abdomen of a recently developed "Vine Weevil" (*Otiorhynchus sulcatus*); and likewise I was able to add some observations, of effect, or non-effect (as the case might be), of different kinds of cake on Wireworms.

The short but very useful observations on trapping were the result of some experiments carried on by Messrs. G. Webb & Co., of Tunstall,

* See more particularly the Special Report on Wireworms from contributions by leading British Agriculturists, in my Annual Report for 1882, pp. 22–63.

near Sittingbourne, Kent, and kindly sent me on May 27th. A consignment of about a hundred and twenty-six beetles was forwarded to me with the information that they had been caught under pantiles in a Hop-ground at Wingham, Kent, and enquiry was made as to whether they were all the Click Beetles which produce the Wireworm attack. These they all proved to be, with the exception of about three specimens of a "Ground Beetle," easily distinguishable by its much larger size, broader shape, and black colour.

The Wireworm Beetles are easily known by being very narrow in proportion to their length, and also by their habit when laid on their backs of regaining their position with a sudden spring, accompanied by a clicking sound, whence their common names of "Skip Jacks," or "Click Beetles." Most of the specimens sent were of the common "Small Brown" Click Beetle, *Agriotes obscurus*, Linn. This is about the third of an inch or rather more in length, the breadth about a quarter of the length, and the shape as figured (magnified) at "3," p. 64. The colour of some shade of brown or pitchy, sometimes with the thorax dark, and the wing-cases lighter or darker, but so clothed with short thick ochrey or brownish pubescence as to give the beetles a general dingy brownish appearance whilst still in unrubbed state.

Besides these, there were about a dozen or more of the "Pasture Click Beetle" (*Agriotes sputator*, Linn.), which is also a common kind, but rather smaller than the above, being from about a fifth to a quarter of an inch in length. It is not unlike *obscurus* in colour, being blackish or brown; sometimes, however, it is wholly tawny, or has the head and thorax (excepting the hinder margin of the latter) black. When fresh it is thickly covered with greyish down.

Both of the above kinds are very common, and are to be found in beetle state in summer *under stones*, on grass, in pasture lands, on hedges—in fact, generally distributed.

The Wireworms, or larvæ, of these and various other species of *Elateridæ*, or Click Beetles, are very well known by their elongate narrow cylindrical shape, and hard yellow shiny coats, altogether resembling a piece of wire of about half an inch, more or less, in length, and less than a sixteenth in breadth. The eggs from which Wireworms hatch are yellowish white and exceedingly small, and are laid in the earth near the plants on which the larvæ will feed, or it may be in some of the leafage near the root, and the duration of the life of the worms may be as much as five years.

As a very special locality for egg-laying, (and one from which the consequent Wireworm infestation is widely spread in agricultural operations), is the surface of grass fields, the method of forestalling attack by preventing egg-laying in such situations has long been known; but the plan of trapping the beetles themselves has not, I believe, been previously brought forward. In localities where it could be carried out, as above-mentioned, in Hop-grounds, and also in Strawberry-grounds, or in gardens where Wireworm infestation may be found to occur yearly, and the field deterrents for egg-laying cannot be applied, the above plan of trapping by laying pantiles, or probably a great many other materials, under which the Wireworms would find a dark shelter, and from which they could at intervals be removed and destroyed, would probably act very serviceably.

I should perhaps mention that on applying to Messrs. G. Webb, of Tunstall, for their permission to draw attention to the successful treatment, they kindly gave it me, with the *proviso* that they must disclaim all originality in the idea, which they believed originated at the conference of Hop-growers at Wye, and that their part of the matter was only having practically carried out the suggestion. But, any way, the observation seems to me to be too serviceable to be overlooked.

Carnivorous Wireworms.—The food of the Wireworm for the most part, or with very rare exceptions, consists of roots of grass, or corn, or succulent roots, as Potatoes, Carrots, &c., of too many kinds to be easily enumerated; but there are some exceptions to the rule recorded, and during last season I was fortunate enough to have an example sent of a Wireworm which had been taken in the very act of perforating a beetle, together with the recently developed beetle on which it was feeding.

On July 29th I was favoured by Mr. Chas. T. Druery, F.E.S., writing from Stanwixbank, 11, Shaa Road, Acton, with the following observations, accompanied by the specimens referred to:—

"I send you herewith an *Otiorhynchus sulcatus*, and I believe a common Wireworm. The weevil you will perceive is pierced through the back. I noticed the latter this afternoon climbing one of my fern fronds with the Wireworm fixed upon its back; in a few minutes the latter had evidently penetrated so far as to seriously weaken the weevil, which then fell off the plant to the ground. I lifted them, and noticed the head of the Wireworm coming out on the opposite side, and hastened to get some hot water, hoping to send you the two together, but unfortunately the worm crawled right through in the interim. If it should be a true Wireworm, we have here a curious case of two pests in conflict, if I may call it so where the weevil was a quite passive victim. Thinking the case may interest you as evidence, at any rate of 'one for the weevil,' I send you the two for inspection."—(C. T. D.)

On examining the specimens sent, the Wireworm proved to be beyond all doubt "a true Wireworm," and appeared to me to possess the chief characteristics of the larva of the large and rare kind of Click Beetle, *Athous rhombeus*, of which it is recorded: "The larva is carnivorous, and lives in decaying trunks of Ash and Beech, where it devours the larvæ of *Lepturæ* and other insects." *

The general colour was pale yellowish, and *along the dorsal segments, with the exception of the one next to the head, were coarse punctures, often more or less confluent, so as to make longitudinal markings.* The specimen had been injured in transit, so that I could not satisfy myself that a short appendage to the terminal segment was the remainder of the "two short bifurcate cerci"; but the large and sometimes confluent punctures along the back of the larva, which are an especial characteristic of this species, were very noticeable. From such expert consultation as I could avail myself of, it seemed likely, but not absolutely certain, that this Wireworm, captured in the very act of preying on the Vine Weevil, was the larva of *A. rhombeus*, Ol., still it might be a larva of one of the other species of *Elateridæ.*

The Vine Weevil, *Otiorhynchus sulcatus*, sent accompanying, and through which the Wireworm was working its way onwards through a good-sized hole which it had pierced in the right wing-case, is only too well known as the black short-snouted weevil, with the rough wing-cases spotted with pale hairy tufts, which is seriously injurious in beetle state above ground, and in maggot state under ground, to Vines and many other plants, and its attacks are especially hurtful to Maidenhair Ferns.

In the instance sent me by Mr. Druery, the attack had evidently taken place whilst the weevil was just developed below ground, for when it reached me the specimen was still flexible and soft, so that the wing-cases were pervious to the Wireworm's biting powers, and, having once well inserted itself, the Wireworm was fairly stuck fast in the abdomen of its prey as it walked up the fern frond. The entrance-hole through the wing-case was roughly gnawed round the edge, and larger by about twice the width necessary for passage of the Wireworm.

I am afraid the above observation can hardly be utilized for practical purposes, but it is perhaps of some intrinsic interest, as an

* I quote the above from 'Coleoptera of the British Islands,' vol. iv. p. 97, by the Rev. Canon W. Fowler, from which I also give the following passage with technical description of the larva verbatim:—"The larva of *A. rhombeus* is described and figured by Schiödte (part v. p. 523, pl. ix. fig. 12); it is less parallel-sided than is usually the case with its allies, and has the segments of the abdomen a little narrowed in front and behind, so that the sides are not even; it is, however, chiefly remarkable for the fact that the dorsal scuta of all the segments, with the exception of the prothorax, which is longer and not so broad as the following, are very coarsely punctured, the punctures being large, and often more or less confluent; the mandibles are very strong and projecting, and the ninth abdominal segment is large, armed with short blunt teeth at sides, and terminated by two short bifurcate cerci; the colour is pale yellowish, with the head and dorsal scuta fuscous."

authenticated record; also it might chance that where *A. rhombeus* is found, as, for instance, at localities in Sherwood Forest, or in the New Forest, &c., in *decayed wood*, that this, if infested, might possibly be used serviceably in potting-plants, as Maidenhair Ferns, for instance, that are especially subject to weevil attack.

The old idea that Rape-cake is beneficial by means of the Wireworms feeding on it until they burst was again alluded to. Relatively to this point, I am able to say that, in order to be certain that the idea was wholly erroneous, I have fed good numbers of Wireworms *wholly* on the ordinary Rape-cake, and also on the Indian or Kurrachee cake, formed of Mustard seed, for weeks together, and found that absolutely and certainly no such results followed. In each case the cake was prepared by being pounded into small lumps and dust, and moistened with water. A far larger supply was given than was requisite for food of the numbers of Wireworms experimented with, and it was placed (each kind separately) in bowls or open vessels in the open air. The Wireworms placed on the ordinary Rape-cake went into it at once, and there they fed (or to all appearance fed) for three weeks or more. After this, as there did not appear to be any use in further observation, I discontinued the experiment, but certainly none of the Wireworms burst during the above period. Some of them died, and I found that then, or when a specimen had stiffened itself in examination, that it was apt to be *cracked* across in handling, and the white contents burst out at the fracture. This circumstance may have given rise to the popular belief.

The Wireworms placed on the Mustard-cake appeared very uneasy from the stinging effects of the recently moistened Mustard, and I furnished them with a little bit of turf, and on about the fourth day afterwards they began to transfer themselves to the cake, where they (presumably) fed for about a fortnight, all of them continuing well and thriving. After this I found many dead or dying, and, though I gave them fresh turf and pieces of Potato and Turnip in addition to the cake, they all died; but *none* of them (any more than any of those fed on common Rape-cake) died of bursting. The benefit derived from Rape-cake dressings as an antidote to Wireworm mischief is in part from its effect as a manurial stimulant in supporting the plants under attack, and partly also from attracting the "worms" away from the plants to a food to which they are excessively partial; but we have no authenticated record of such inflation taking place from the food as to cause bursting.

Effect on Wireworms of Castor-oil seed cake, Rape-cake, and also of absence of food.—The following details of experiments carried on during a period of three months by Dr. Bernard Dyer (Laboratory, 17, Great Tower Street, London, E.C.), relatively to effect of Castor-oil seed cake and Rape-cake on Wireworms, was kindly placed by him in my hands, with the remark (Nov. 14th, 1898):—"I have been trying if Cotton-oil cake (very deadly to mammals) would kill Wireworms. The experiment is a very rough one. Enclosed is a description of what happened."—(B. D.)

"*Description of experiments on Wireworms.*—One hundred worms were placed in each of three jars of earth, and fed respectively with Castor-oil seed cake, with Rape-cake, and with nothing. The cake was given in great abundance in both cases, being applied as fast as the worms seemed to dispose of it—that is to say, as fast as it disappeared, though the disappearance may not have been entirely due to its consumption as food, but partially to decomposition.

"By the end of two months about a third of an ounce of cake had been supplied to each jar. The soil in each case only weighed about ten ounces, and the cake applied must have been at the rate of far more than one hundred tons per acre; so that the experiment, even if an exaggerated one, seemed well calculated to show whether there might be any specific difference in the effects of the food supplied. The earth was of course kept equally moist in all three cases.

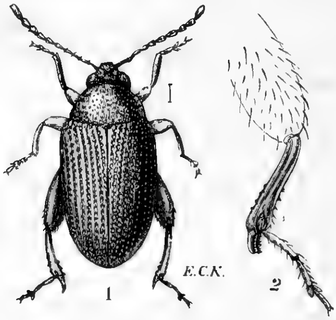
"At the end of three months the pots were turned out, and it was found that, of the hundred worms which had had no food at all in addition to the earth in which they lived, ninety-eight were alive, though their condition was very meagre; of the hundred worms supplied with castor-oil seed cake, ninety-three were alive and in good condition; of the hundred, however, that had been fed upon ground Rape-cake, only six were alive.

"It would appear, therefore, that Rape-cake, when supplied in such superabundance as in this experiment, brought about a large destruction of the worms, though it does not by any means necessarily follow that it would do so when used on the small scale adopted in actual farming. On the other hand, it seems to be abundantly clear that Castor-oil seed cake, although it is virulently poisonous to higher animals, fails to exercise any poisonous effect upon Wireworms, which are apparently indifferent to its acrid poison.

"Still more cake was given, but this cake, the weather being warmer, decomposed, and the soil became infested with smaller life, which seems to have brought about conditions uncongenial to the Wireworms; and it may be also that the effects of crowding for so long a time without change of soil were bad for them; for first the cake-fed ones died, and then those without food."—(B. D.)

The foregoing observations need no comment beyond Dr. Dyer's own remarks as to the presumable cause of the ultimate death of the Wireworms *after* the period of three months had expired, of which notes are given. But two of the special points recorded well deserve attention; one of these is the observation that Wireworms *can exist* (although they did not thrive) for three months upon an almost infinitesimal amount of food, a fact which may be utilized for field work, as showing that, *with this pest,* leaving the ground uncropped for a time would be of no service in clearing the land of the infestation, as it is with various other of our field attacks. The experiment with the Castor-oil seed cake, showing its *harmlessness to Wireworm life,* is also a valuable record, both as a scientific fact and also as reliable authority to turn to, which may save unnecessary outlay, and also some disappointments in field experiments as to preventive treatment for Wireworms.

Hop Flea Beetle; Hop-cone Beetle. *Psylliodes attenuata*, Koch.



Psylliodes attenuata.—Beetle, and hind leg, magnified.

The attack of the Hop Flea Beetle, or, as it may quite as correctly be described, the Hop-cone Beetle, is one which it may be serviceable to draw attention to, as it is at times very injurious in Hop-gardens in maggot as well as in beetle condition. In the beetle state it does harm by feeding on the leaves and shoots of the young growing bine, and in maggot state is mischievous by feeding in the scales or bracts of the cones.

In regard to the beetles, the first observation that I received of them was on April 22nd, 1882, when specimens were sent me from Kingsnorth, Kent, by Mr. T. H. Hart (who was a trustworthy agricultural entomologist), with the remark that this kind might be considered "*the*" Hop Flea of the district—the damage caused by the "Tooth-legged" or "Brassy" Flea Beetle being small in comparison. He further noted that nine-tenths of many hundreds taken in Hop-gardens proved to be of this species, but that at a distance from such gardens he had seldom found it.

Since then I have had no further notice of the attack of the beetles until the notes of the mischief they had been causing on Hops were sent me (see p. 72 following) from near Hereford in May of the past season.

These beetles very much resemble many others of the great division of "Flea Beetles," of which the Turnip and Cabbage Flea Beetles are only too well known, and like them they have the thighs of the hind legs much enlarged and formed for leaping, but are distinguishable (as figured at p. 70) by the foot of the hind legs being appended, *not* at the tip of the shank, but a little way above it. The Hop Flea Beetle (*P. attenuata*) is elongate ovate, rather than oblong ovate, in shape, somewhat over a line in length (two and a third to two and three-quarter millimètres), brassy or greenish brassy in colour, with the tip of the wing-cases to some degree of a reddish tint, and these about three times as long as broad, with deep punctured striæ, the spaces between also distinctly punctured. The head small, "with two distinct furrows between the eyes which cross one another and form an X"; legs somewhat reddish, with the hinder thighs and the base of the foremost and intermediate thighs dark.

The great distinction of *Psylliodes* from the other allied genera, however, consists (as mentioned above) in the hind pair of feet (*tarsi*) being inserted, *not* as is commonly the case at the tip of the shank (*tibia*), but a little way up; and by this, with the presence also of the X-shaped mark on the forehead, which is commonly although *not* invariably present, *Psylliodes attenuata* may be clearly recognised. It is of a good deal of convenience to bear these distinctions in mind in identification of Hop Flea Beetles, as there is another kind, *Plectroscelis concinna*, Marsh. (the *dentipes* of Koch), known popularly as the "Tooth-legged" or "Brassy" Flea Beetle, which occurs on Hops, as well as Turnips, and much resembles *P. attenuata* in general appearance.

The distinction of this species (*P. concinna*) is that *it has a tooth on the outer side of the shank of both of its two hinder pairs of legs*, whence it takes its name. It is smaller than *attenuata*, being from rather under to rather over a line in length, of a less elongate shape, and, though resembling in colour, is more of a bronzy tint, and is *black beneath*; the legs also differ in having more or less of the shanks and feet dark.

As *attenuata* especially frequents Hops, and *concinna* is one of the Turnip as well as Hop Flea Beetles, the distinctions between the two kinds are of some importance in agricultural service.

On May 15th I was favoured by the following observations on presence and method of injury of the beetles of the species *attenuata* to Hops, sent me from Buryhill Lodge, near Hereford, by Mr. Geo. Bonnor:—

"I have seen these beetles on the Hops several years ago, but they never did any damage before last year, only on the leaves when two or three feet high. Last year they got on the young shoots, and stopped their growth altogether. In a yard where I generally have ten or thirteen tons, I only had a little over three, through their puncturing them so.

"I put flower of lime, soot, and sulphur in a fine powdery condition on them, all to no purpose. . . . This year I have washed them with a strong solution of soft-soap and quassia and half a pint of paraffin, all to no purpose, as they were as thick as ever next day, seventy or eighty on one root. The best thing to keep them off that I can find out up to the present time is to keep powdering them with basic slag, put on through coarse bags.

"I may say it was only one other yard besides mine that was affected last year; this time five or six all round here. . . . I think the mild winters that we have had lately have something to do with them being hatched out earlier than usual. They do not seem to hurt the Hops when they have a fairly good start."—(G. B.)

Amongst points of interest in Mr. Bonnor's notes, one that it seems to me might very likely be utilized practically is the observation that the beetles appeared again in such great numbers (as many as seventy or eighty on one root) the day after they had been cleared by such a very stringent application as a wash of soft-soap, paraffin, and quassia. As Mr. Bonnor's washing must have been applied some time before the date of his letter to myself (May 15th), this renewal of attack must in all probability have arisen from beetles that had wintered at the roots of the Hops, and from beetles developed from maggots which had fallen from *their regular feeding places* in the cones of the Hops in the previous season, and had then gone through their changes to beetle state in the earth or in rubbish on the surface, and appeared (old and young together) in a similar manner to the Turnip Flea Beetles early in the season.

Mr. Bonnor mentions the attack as having been gradually increasing in the Hop-grounds mentioned during the last few years, and the localization of the headquarters of the spring origin of the attack may help us very much towards getting rid of it.

The following information is given by the Rev. Canon Fowler* with regard to egg-laying in the Hop-cones and hybernation of the beetles:—"The beetles get into the cones of the Hops and deposit their eggs, and the larvæ when hatched burrow through the bracts of the cones, and make them lose colour and become disintegrated; the chief damage, however, is done in early spring, when the Hop-bines are just sprouting, by those beetles that have hybernated in the old

* 'The Coleoptera of the British Islands,' by the Rev. Canon Fowler, vol. iv. pp. 388, 389 (which see also for full description of beetle).

hollow, dead bines and other refuse; it is therefore most important that all rubbish should be removed and destroyed."—(W. W. F.)

The damage caused by little white maggots feeding in the Hop-cones until, as above described, they lose colour and become disintegrated is at times a subject of serious complaint.

In September, 1882, Mr. Goodwin, writing from Cranch, near Maidstone, mentioned, with regard to this small white maggot, that it pierced into, or rather was bred in, the strig or stalk of the cone or flower, where it eats its way up the inside of the stalk, thus causing the Hops to wither and turn brown. The maggots varied in number in one "strig," but one or two were the average. In the earlier part of September these maggots were very numerous; but at the date of writing (September 27th) they had disappeared, and it was mentioned that "they drop out into the earth after eating the Hops."

Specimens were also forwarded to me by Mr. R. Cooke, from Detling, near Maidstone, of Hops similarly attacked, with the mention that the altered colour was from the attack of a maggot which channelled out a home for itself in the stem which forms the centre of the cone.

Examples of the infested Hop-cones were repeatedly sent me in 1882, and have been occasionally forwarded since; but I have never had the opportunity of technically identifying the larva so as to make quite sure that the *Psylliodes attenuata* was the cause of the mischief. At that time it was not known where this Hop Flea Beetle propagated, nor, so far as I am aware, were descriptions of the maggot attainable. But it seemed to me most likely (see my Annual Report for 1882, p. 71) that, if we could rear the maggots to maturity, they would prove to be those of this *P. attenuata*. Since then Canon Fowler's work on British beetles (quoted *ante*, p. 72) has added very greatly to our stores of useful information, and his notes on the egg-laying of the Hop Flea Beetle in the cones appear to me to leave no reasonable doubt that the injuries in the specimens sent to me from time to time during the past seventeen years are the work of this beetle.

Prevention and Remedies.—The first points are treatment in early spring. The Hop Flea Beetles which remain from the previous season hybernate (that is, spend the winter) in any convenient shelter in or near the Hop-hills, as, for instance, in the stumps of the old dead bines or other refuse; and (so far as is possible) clearing this away will remove one source of coming trouble.

As the maggots, which in the Kentish observations were noticed feeding in autumn, *dropped from the Hop-cone to the ground*, it is obvious that these must go through their transformations at the root of the Hop, and, they being so very small and tender of structure, it would be worth while (where the pest appears to be establishing itself, as observed by Mr. Bonnor, p. 72) to try whether a surface dressing of some application that would be sure *not to hurt* the Hop plants might kill the beetles at the roots whilst still in larval and chrysalis condition.

Kainite sometimes acts very well in preventing development of maggots to their perfect condition, and might be well worth experimenting with.

A mixture of paraffin applied at the rate of one quart of paraffin to one bushel of dry material (as ashes, sawdust, shoddy, &c.), and given so as to thoroughly cover the ground of the hills; or, again, a wash of paraffin and soft-soap might be applied, so far as common practice or experiment shows, without any danger of injuring the Hops; and from the excellent effects of paraffin or mineral oil as an insecticide, it might be hoped that a wash of this and soft-soap given to the ground early in the year might kill the maggots or chrysalids if lying near the surface. In the experiments which were carried on in 1884 by Mr. A. Ward at Stoke Edith Park, near Hereford, by kind permission of Lady Emily Foley, relatively to checking appearance of Hop Aphis from the ground of the Hop-hills in spring, upwards of seven hundred hills were thoroughly dressed over the surface with paraffin in dry material, as above mentioned, and the plants did well during the whole time of observation recorded, which was from May 3rd until August 21st; the Hop plants which had been treated with the paraffin and dry material looked well and bore well. The experiments included the somewhat severe trial of pulling the shoots off two rows, but the stocks sent up strong shoots again *through* the paraffin dressings, thus showing that the tender young leafage was not hurt.

Gas-lime, which is sometimes useful as an insecticide, when applied as a dressing was found to be very injurious; of the various rows so treated all were weak and sickly, and one row died. From this observation it would seem that the excellent recipe known as that of Fisher Hobbs's, which answers so well to check Turnip Flea Beetle attack on leafage, might be less safe here. This, as it will be remembered, is composed in proportions of a *bushel of fresh gas-lime* to a bushel of fresh lime, and smaller quantities of soot and sulphur.

In Mr. Bonnor's notes of his remedial experiments (see *ante*, p. 72) he mentions that he applied "flower of lime, soot, and sulphur in a fine powdery condition, but all to no purpose"; but he does not mention the time of day of the application.

With all powder dressings applied to check Flea Beetles, it is very important that they should be given in morning or evening when the dew is on, or when, from weather influences, the leafage is damp, so that the dressings may adhere to the leaves and to the beetles, and thus be an effectual check on their operations. The only application which Mr. Bonnor mentions as being of some service is that of "basic slag."

In a short bulletin by Prof. Clarence M. Weed, Entomologist of the New Hampshire College Agricultural Experimental Station, U.S.A., entitled 'Remedies for Flea Beetles,' I find the use of the two following recipes for washes, strongly advocated, after trial "on a variety of garden crops," *but I have no knowledge of what the effect might be on a kind of crop of such special nature as our Hop plants.* There is no reason to doubt that they could be safely and most probably serviceably used; but, as with all other mixtures used as washes, experiment should be made on a few plants as to the strength of wash that may be safely applied to the leafage before proceeding to use it on a broadscale.

One of these applications consists of "a spray of lime-wash made by adding a pint or more of freshly slaked lime to two gallons of water, and then thoroughly *mixing in* about half a teaspoonful of Paris-green. . . . The lime dries on in a firmer coating than when simply dusted on, and consequently is more effective."

A still more certain remedy (Prof. Clarence Weed remarks) is found in the use of the Bordeaux mixture, for which he gives the following recipe:—

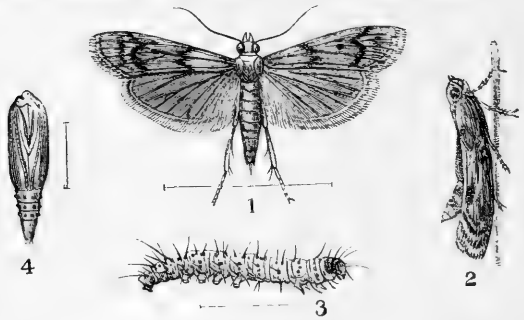
"Dissolve five pounds of copper sulphate (blue vitriol) in two or three gallons of hot water in an earthen or wooden vessel. Pour into a barrel, or tank, holding fifty gallons, and add water enough nearly to fill it. Now slake five pounds of good *fresh* lime in two or three gallons of water, and pour into the barrel, straining through a sieve as it goes in. Mix the two thoroughly, and the preparation is ready. In applying for Flea Beetles, or to any crop which is liable to injury by insects, add four ounces of Paris-green to each fifty gallons of Bordeaux mixture."—(C. M. W.)

The small amount of Paris-green suggested as an addition to the lime-wash, and also to the Bordeaux mixture, which is customarily used as a "fungicide," would be certain to make the action in either case much more surely destructive to the Flea Beetles; and Paris-green, or Emerald-green, as it is sometimes called, has now been for so many years in use with us as an insecticide that it is not perhaps necessary to continue to repeat the warnings that care is requisite in using it, as it is *a poison.* It is an arsenite, or aceto-arsenite of copper, and of a beautiful green colour, making it very attractive to children; and to save risk of accidents, whether to children or from carelessness generally, the green powder should always be kept under lock and key, and only given out when needed, and into trustworthy hands.

In regard to its application. The date mentioned of appearance of the Hop Flea Beetles on the leafage or young shoots of the Hop is (see *ante*, p. 72) April and the early part of May, whilst the shoots are still young and tender, and by many weeks before the season of even the beginning of the formation of the cones, consequently there is not the slightest possibility of the application doing harm to the crop. Trial, as mentioned above, would be necessary to ascertain what proportion the Hop leafage would bear safely, and (this being clearly known) the applications might be, after similar trial, found serviceable in other cases of crop "Flea Beetle" infestation, for which we are much needing to know of some broadscale applications.

MILLS.

Mediterranean Mill Moth. *Ephestia kuhniella*, Zell.



EPHESTIA KUHNIELLA.—1, moth, with wings expanded; 2, moth, at rest; 3, caterpillar; 4, chrysalis—all magnified, lines showing natural length.

This very seriously injurious flour mill infestation has been continuing to spread, until now it is widely prevalent in England and Scotland, and also to some degree in Ireland; and, though some remedial measures lessen to *some degree* the presence of the pest, I believe I am right in saying that none of these can be applied without risk of some sort or other, as to affecting condition of the flour, or of the mill apparatus, and also entailing much trouble, and, at times, considerable loss from temporary stoppage of mill working.

The matter has often been entered on in my preceding Annual Reports since 1888, in the autumn of which year the first complaint of observation of the infestation as a serious mill pest was sent to myself; but now in the serious difficulties from its presence, and also, as still in some instances the nature of the attack does not appear to be fully understood, I think it may be of use to give the main points of the subject brought up to date, including amongst these, first, notes sent me in the course of the past year showing the prevalence of the pest, and the very great difficulty of bringing remedial measures really and practically to bear on the matter, and afterwards detailed descriptions of the appearance of the moth, egg, and caterpillar; also life-history and habits of the infestation, its regular and its occasional food, the countries where it is known to exist, and likewise means of prevention and remedy which are recommended.

So far as material allows, I have described from reports placed in my hands from the commencement of the attack in 1888 in our own country (as this infestation is one that is affected by temperature), but have also quoted (referred to as occasion requires) from the admirable Monograph of Mons. J. Danysz, Director of the Laboratory of Pathology of the Bourse de Commerce, Paris; from the information given in publications of the Department of Agriculture of the U.S.A., and other sources.

The following communications, which were sent me in the past season referring especially to the great spread of this flour mill scourge, were forwarded to me by millers working roller mills on a large scale, and, being in business confidence, I am not permitted to give names or localities.

It will be seen that the first observations mention the spread of the "scourge," until now it is "troubling most millers of the United Kingdom"; and also what (so far as I can venture to think myself able to understand the bearings of the matter) I believe to be a great factor in this general spread—namely, the systematic concealment of presence of attack, the complete secrecy (so far as is possible) which is preserved by those troubled with the pest. Thus all concerned lose much help that might be given by consultation and comparison of experiments, and also debar themselves from the protection from transmission of infestation which would be given if general presence of the pest was acknowledged, and sacks, bags, and similar vehicles of flour transport were, as matter of course, disinfected. Notes are also given as to *why* various methods of prevention and remedy usually recommended for mill use fail in their effect, or do mischief coincidently, as, for instance, by fumigation tainting the flour, and of flour if subjected to the influence becoming a wet mass.

The notes were sent me, after some correspondence, on May 20th in the past season, and I give them verbatim:—

"In reference to the scourge of moths at present troubling most millers of the United Kingdom. . . . Of course the millers do not wish their customers, or, indeed, anyone, to know they have the moth pest, and on that account they will not even communicate to each other on that matter, lest the travellers should give the information to the customers, and much damage be done thereby.

"However, hardly a miller has escaped without them, and we and other two millers in . . . have had to take down almost the whole mill machinery, and put the iron screws and other parts through fire to clean them. The best-known remedy to us is mineral oil, but this of course does not get at the maggot, and the fly keeps away from it. However, it is a good help in keeping them from settling down. Again, it is not a good remedy in a mill, so much use of oil; it is dangerous for fire, and you must keep it out of the way of flour passages; only external use. Irish lime is no use in a short time.

"We can only keep the infestation under by laborious cleaning, and this at a big sacrifice of flour. Mr. Henry Simon, of Manchester, the chief milling expert of Britain, has been applied to many times by millers, and cannot give any safe advice on the matter."

A sample box containing specimens of the moth and maggot causing the trouble referred to above was forwarded to me by the writer, showing plainly that the infestation was that of the "Mediterranean Mill Moth" (*Ephestia kuhniella*).

On May 27th the writer further continued:—

"With respect to the treatment of white-washing with fresh-slaked lime and oil, that is our chief work with the fumigation by means of sulphur in tubs in different parts of the mill, and all the doors and windows closed, but this does not get to the inside of rhones and screws, where they live chiefly. We are not troubled in our Wheat stores, it is only in our roller mills, where the Wheat is ground and dressed into flour, and they seem to propagate and thrive in the inside of flour rhones, collecting-bins over the top of rollers, and in the seams of the wooden floors, though there we get at them easily and destroy them. Semolina in passing down rhones will sometimes receive the eggs or germs of life, and after sitting for a few weeks in the sacks will develop the maggot, which gathers a kind of fibre around it, even in the centre of the sack. In flour also you will find it indicating that it can live seemingly excluded from the air.

"In the matter of steam, we have a three-inch pipe going up through all our flats, with an opening to each flat, but this is only to be used in case of fire. However, we tried it once during an alarm of fire, and it did great damage to the silk cloths for dressing, and in turning the dry flour in rhones and screws into paste, through the condensation of the steam.

"The test of heating the Wheat up to a temperature which would destroy the eggs or germs of life seems a very easy plan, and while the arrangement might be a little expensive at first, it might be the most economical in the end. From the time we lift our Wheat ex-ship in sacks, they are never emptied till the Wheat is being put on the mill. I understand that many of the mills in England and two or three in Scotland have adopted a plan of washing all their Wheat first, and then subjecting it to a high temperature (safe) before it goes on to the cleaning machinery; but I have not yet learned if this has been a preventive of the moth pest. It was not put in with that intention, but as a means of obtaining better results in the manufacture of flour.

"I have great fears of handling poisons through inexperienced men, and warm flours—Semolinas and offals—are so powerful in absorbing odours near them—even in the outside court the smell of asphalt has been taken in by flour three flats up in store. You will notice that our case is the dealing with the products of Wheat in its different stages of Wheat-meal, flour, and cattle feeds, not Wheat; we have no trouble there, though if we could kill in the Wheat what afterwards troubles us in the ground meal and flour stages it would be well."

The following communication turns chiefly on the great loss (even to the extent of necessitating "tons of the spun flour" being burnt) which ensues on this moth attack being allowed to gain possession. The observations relatively to bisulphide of carbon refer to my mention that fumigation by this means was *the especial* remedial agent recommended by the Department of Agriculture of the United States; but at the same time I most forcibly requested my correspondents would note the risks attending the application—namely, the excessive inflammability of the vapour, not only in case of presence of light, but also (as I have myself seen take place) of ignition occurring merely from raised temperature; and likewise the very possibly prejudicial effect of the vapour of the bisulphide to the health of those who might be exposed to it, unless due care in subsequent ventilation was exercised. The communication was sent me on Dec. 5th, 1899:—

"We are flour millers, with a modern roller mill, which works automatically, that is, the Wheat is put in at one end of the mill, and, although in process of manufacture it is turned into dozens of different qualities of material, each is conveyed from one machine to another by spouts, elevators, screw conveyers, &c., and is not handled till each finished quality arrives at its packer.

"Lately we have had several lots of flour returned to us, our customers complaining that the flour was full of maggots, which, on examination, we found was the fact.

"We then had a thorough examination of our mill, and found every one of the spouts, conveyers, elevators, and machines simply alive and grown up with maggots and moths, samples of which we send you under separate cover.

"We should like your opinion as to the origin of these maggots and moths. Are they native, or have they come from some foreign country, say in the Wheat? (We use Wheats from all parts of the world.) How are we to get rid of them, and kill the eggs? In answering this please note that nothing with a strong smell can be used, as flour takes a smell from anything very easily.

"We may tell you that our mill has been working for the past twelve years or more, and until now we have never seen the slightest sign of a maggot or moth in it."

On Dec. 8th, after some preliminary observations relatively to my reply to their enquiries, my correspondents further remarked:—

"At present we are continuing cleaning the mill as best we can, and have taken tons of the 'spun flour' and maggots out and burned them in the furnace.

"We are going to consult" [here the name of a well-known chemist was given.—E. A. O.] "as to whether he understands and will undertake to fumigate the mill with bisulphide of carbon, or can get us someone who does understand it. If he cannot, perhaps you will assist us. However, before doing anything further in this direction, we will have to get the permission of the insurance companies, as it might vitiate our insurances.

"Of course our mill is entirely stopped, and it will take us many weeks if not months before we will get started again. We need hardly tell you that this is a very serious loss.

"We have no objection whatever to your publishing the facts of the case, provided you do not mention anything to identify it with our mill."

In regard to the appearance and habits of *Ephestia kuhniella*, the moth may be generally described as of a grey colour, with the fore wings, which are about seven-eighths of an inch in expanse, of a grey-ground colour, with various lighter and darker markings, and the hinder wings of a dirty white. But for technical reference I give the detailed description by Mons. Danysz, quoted from his work, referred to below*:—

"Distinctive characteristics of the species.—The *Ephestia* is a moth of from ten to fourteen millimètres in length" [two-fifths to rather less than three-fifths of an inch.—E. A. O.] "and of a more or less decided grey. The head is of a deep tint, and bears long antennæ. The thorax is clouded with grey and black; the abdomen is greyish. The upper wings are of a rather deep grey with some white dots. The hinder edge of these wings bears a series of black dots, in line one

* '*Ephestia kuhniella*, Parasite des Blés, des Farines et des Biscuits. Histoire Naturelle du Parasite et Moyens de le Détruire.' Par J. Danysz (Directeur du Laboratoire de Parasitologie de la Bourse de Commerce). 'Mémoires du Laboratoire de Parasitologie Végétale de la Bourse de Commerce.' Paris. 1893.

after the other, and which sometimes are enlarged into a kind of small discs. These black dots form by their aggregation a black line edging the well-developed fringe with which the wings are ornamented. The upper surface of the wings is marked with numerous irregular black spots, which form two transverse lines, more or less interrupted and indented, and on the disc is an irregularly-shaped crescent-like marking. The lower wings are of a dirty white; the veins are grey, with a band of a deeper tint bordering the fringe.

"The egg is white, ovoid, visible to the naked eye; its smallest dimensions are 0·30 mm. in length to 0·20 mm. in width; the very fine shell bears on its surface small elevations, arranged in stars, which are very characteristic. The egg of *Ephestia* does not pass the numbers of bolting silks ('*soies à blater*') higher than No. 70."—(J. D., *loc. cit.*).

The caterpillar (*larva*) may be shortly described as about half an inch in length, of rosy white or sometimes of a rose colour. The head reddish or yellowish brown, and a dark patch on the top of the segment next the head, and also a dark-coloured plate on the caudal segment.

In 1888 I had opportunity of first examining larval specimens, and found the details of samples sent me from an English mill, of which the moths accompanying proved on comparison with type specimens to be the true *Ephestia kuhniella*, Zeller, as follows.

The caterpillars varied in size from two-eighths up to five-eighths of an inch in length, and correspondingly in colour, the younger ones being of a flesh or pale red colour, and the largest almost white; the shape cylindrical, somewhat slender, with sixteen feet—that is, three pairs of claw-feet, four pairs of sucker-feet, and also a well-developed pair of sucker-feet beneath the tail segment, by the help of which, although the largest of the larvæ were sluggish, the younger travelled nimbly, and could move backwards or forwards at pleasure, or were able to attach themselves at once to a foreign substance, as the finger or hand.

The head yellowish brown, darker in front, and with dark brown jaws; a transverse patch on the segment next the head, this rather pale yellowish brown in my specimens (but the depth of tint apparently variable) with a faint pale central line dividing it from back to front, and (in the oldest specimen) a small brown spot on each side of the segment below the patch.

Along the back, excepting towards the head and tail, were four small dark dots on each segment above, two on each side the centre. On the segments near the head, the spots were arranged more transversely; and at the tail extremity, immediately above the sucker-feet, was a brownish oval or somewhat triangular patch (the anal plate). On the preceding segment the transverse row of spots varied somewhat in different specimens; the largest was in the middle, with a smaller one on each side, and occasionally one below, making five altogether; but sometimes the lowest pair was absent; sometimes the middle large spot was not entire, conjecturally the marking differed with the age of the caterpillar. On the preceding—that is, the eleventh—segment, there were two clearly defined brownish spots, and along each side of the caterpillar was a row of dark dots, one on each segment.

The caterpillar was slightly sprinkled with pale hairs, or fine bristles, and had such a capacity (consequently) for catching and retaining a covering of flour, that I was obliged perpetually to remove it with the moistened tip of a finger in order to obtain a clear view of the markings.

The chrysalis (which lay in a silken cocoon of spun-up flour) showed the chief points of the form of the coming insect plainly; the colour was that of beeswax below, shading to reddish brown on the back, and reddish brown also at the end of the somewhat prolonged, slightly curved tail, which ended bluntly or cylindrically; the eyes were of a darker shade of red.

I had not the opportunity of observing how long the chrysalis state lasts before development of the moth, but it is stated by Prof. Zeller that the time taken is three weeks.

The rapidity of succession of generations of *Ephestia* is influenced by temperature; where this is favourable, as in mills working day and night, it is found that there may be *five* or six successive generations yearly.*

The method of life is for the minute maggot, which is almost invisible to the naked eye when it comes out of the egg, to begin immediately to spin a fine glutinous silk, or web, so tenacious that it adheres firmly to the smoothest surfaces, and thus the bolting apparatus, woodwork, machinery—in fact, everything that the caterpillars can get at—become covered with a thick coating of whitish web, with grains of flour or meal attached. As the maggot (larva) grows—which it does so rapidly that in three or four days (unless the weather is not too cold) it is a line in length—it remains within the sort of "felt"-like web as long as food is in reach; but when this ceases to be the case, it comes out and spins a new layer of web on the top of it, and this process is continued until great masses are formed of the spun-together flour. In my own experiments I have seen flour felted by a colony of *Ephestia*, which I kept under observation, into a mass ten inches long by six wide and about an inch deep, this mass being webbed firmly together throughout. On the broadscale and widespread amount of observation which it was in the power of Mons. Danysz to carry out, he mentions having seen these spongy, elastic spun-up masses measure several "metres" in length. As a "metre" equals

* See '*Ephestia kuhniella*,' by J. Danysz, pp. 10–14 (referred to in note, *ante*, p. 80).

thirty-nine English inches in length, this will convey to those unacquainted with the importance of the subject some idea of the mischief caused in milling operations by continuous yards of felted-up flour.

In one of my earliest reports from steam mills in the north of England, the miller put the matter shortly:—"They get into the spouts and machinery, and do no end of mischief, both by destroying the silks, and stopping the flow of flour, &c."

But where once the infestation gets even a slight foothold, thorough possession follows very rapidly, as shown in the following extracts from the exhaustive report kindly placed in my hands by the Department of Agriculture, Ontario, Canada, whilst I had the honour of being in communication with them on the infestation on the occasion of the first appearance of *E. kuhniella* in that country.* The locality was at some large steam mills in the Province of Ontario.

The first appearance of the moth, so far as known, was during the month of March, 1889:—

"The moth was seen flying about near a steam-pipe in the basement of the mill, but little attention was paid to it. 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 were steadily increasing in numbers.

"About the middle of July we shut down for a day or so"; and details are given of treatment of clothing from bolting-reels and of elevators. Then every corner and part of the mill having, *it was supposed*, been thoroughly cleaned, work was commenced again, and after about four days, bolting-reels, elevators, &c., were found 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 completed infested with moths, cocoons, and caterpillars, and there was no use going on. . . . 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."

The Dominion Government having happily on their staff thoroughly efficient advisers, both scientific and practical, in the persons of their

* See 'Bulletin 1, Provincial Board of Health of Ontario': "The Flour Moth, *Ephestia kuhniella*." Issued by the Ontario Department of Agriculture.

Entomologist and Director of the Experimental Farm Stations, and the exceedingly stringent measures advised *being enforced by an Order in Council*, approved by His Honour the Lieutenant-Governor, the pest was stamped out (*pro tem.*), and remedial measures arranged to be brought to bear should re-appearance be threatened. But the loss from this attack, and requisite treatment, amounted, as stated in a letter to myself, written on Sept. 21st, 1889, from the owners of the infested steam mills, to about £1000.*

The notes given at p. 79, preceding, by one of my enquirers working some large steam mills, describes the too frequent state of affairs thoroughly: "We had a thorough examination of our mill, and found everyone of the spouts, conveyers, elevators, and machines simply alive and grown up with maggots and moths, samples of which we send you"; these, as before mentioned, proved to be of this widely-distributed flour-mill scourge, *Ephestia kuhniella.*

With regard to the food of the Ephestia caterpillars.—In this country, as we know to our cost, it frequents flour, and although (from extra-British records) there is no doubt that on occasion it attacks grain, I have not, in the twelve years during which enquiries have been sent me, had a single note of it as a grain pest with us.

It is technically described by Mons. Danysz as "the parasite of corn, flour, and biscuits"; in the United States it is officially recorded by Mr. F. H. Chittenden that "although the larva prefers flour and meal, it will attack grain when the former are not available, and it flourishes also on bran, prepared cereal foods, including Buckwheat grits, and crackers."

The injury to biscuits has not been reported with us; but in the monograph on this attack by Mons. Danysz (previously referred to) this injury is recorded as occurring on a very large scale in France in connection with the army supplies, and amounting at times to as much as half or the whole of the store. The details and statistics of this, and the preventive measures requisite, are entered on with very serviceable clearness at pp. 23–26 of the work (previously cited).

In the case of what is considered to be the first recorded observation of the presence of the attack in this country in 1887, the moths were bred from "Rice-cones," which shows their capacity of at least infesting rice products.†

The geographical distribution of the infestation has spread so steadily since 1887, before which date it was little observed, that now it is certainly widely distributed in Europe and in North America. We

* See Bulletin referred to in note preceding, p. 83.

† I am not personally aware of the nature of "Rice-cones," but am informed, on enquiry at a baker's, that this is a name given to a form of ground Rice used for rubbing the inside of troughs to prevent the dough adhering.

know of it from published accounts as being present in Germany, Holland, and Belgium, and also at various of the Mediterranean ports. In some of the more recent enquiries sent to myself in the course of examination of samples of condition of flour from about one hundred and thirty barrels, imported from an Hungarian mill, I found (besides what was the special subject of enquiry) lumps of the clotted-up flour, which is a sign of *Ephestia* presence. Also in the case of two shipments of flour from an Adriatic port the outside of the sacks were found on landing to be thickly infested with maggots and cocoons, which my correspondent, from his own study of the subject, considered to be of *E. kuhniella;* and, so far as the specimens sent enabled me to judge, I saw no reason to doubt his identification.

In Canada it appeared as a serious flour mill pest in 1889 (two years after the date of the first recorded observation of its presence in England). In 1892 it was found present in mills in California, and in 1895 its appearance was observed in New York State. It has also been reported from North Carolina, Alabama, Mexico, Colorado, and likewise from Chile. Thus, looking at the vast area of known infestation, and the probability of a greatly increased spread having further occurred, there is a presumption that flour imports from most parts of the world are liable to be *Ephestia*-infested, though (practically, considered in the point of view of our own protection) this matter has long since ceased to be material to us in England and Scotland, from the widespread prevalence of the trouble. Up to the present date I am not aware of it being as widely dispersed in Ireland.

The rapidity of the spread of this *Ephestia kuhniella*, the "Mediterranean Mill Moth," is probably rightly ascribed to "the higher and more equable temperature maintained in modern mills, a condition highly favourable to the development of the insect" (F. H. C.).

Prevention and Remedies.—One point on which something might certainly be done is to check ingress and egress of the pests in egg and caterpillar condition. It is not only in mills that the infestation is present, but the caterpillars are to be found in flour at bakers', and are constantly transported to and fro with eggs and cocoons in and on sacks of flour, and likewise in and on the empty sacks which have carried infested flour, and which, when sent on without due disinfection, transmit the pest constantly more and more *throughout the country.* The caterpillars have almost an extraordinary power of pervading every part of a building. In Bulletin 1, on the Flour Moth, issued by the Ontario Department of Agriculture in 1889, p. 11 (as a *working example* of this), an account is given of a large warehouse, some 25 ft. wide, 75 ft. long, and four storeys high, which became literally alive with moths in the course of six months, "while thousands upon thousands of the cocoons were found adherent to the walls, joists, posts, ceilings, in every nail-hole, cracks in floors, partitions, machinery, furniture, throughout the whole building"; also in sample-boxes of cardboard, in small and large bags, and in flour stored anywhere throughout the building the pest was abundantly present.

On a lesser or greater scale, as the case may be, whether in roller mills, bakeries, flour warehouses, or wherever flour of the kind infested by *E. kuhniella* is stored, the pest may now exceedingly likely be found, and one preventive measure strongly advised is, where danger of introduction is suspected, *to quarantine the goods or bags in a warm place* for a sufficient length of time for the infestation, if present, to show itself, and for measures to be taken accordingly.

Also it is most strongly advised (where cause exists for suspicion) to have the consignment, whether large or small, inspected by a *qualified examiner*, and if infested refused. The presence of this kind of caterpillar may be distinguished to a great degree by their *rosy* or *reddish colour*. In the official pamphlet of Mons. Danysz, he notes that this is a quite trustworthy guide. In my own observations I have found the younger caterpillars flesh or pale red colour, and the largest *almost* white; but in infested consignments quite sufficient of the caterpillars would still be in the obviously reddish stage to draw attention of all concerned to the matter, and the details of appearance and habits given at pp. 81 and 82 would be quite enough to pronounce on, even for legal depositions.

If in the case of the two shipments from the Adriatic port, mentioned at p. 85, these were sent on to customers; they must have carried the infestation with them, and the *refusal of infested goods* is most strongly dwelt on in the official pamphlets of other countries now before me as an important preventive measure.

Another point is that all bags which have been used for transporting grain, flour, or meal should not be admitted unless subjected *under inspection* to thorough boiling, superheated steam, baking, or other treatment which is absolutely certain to destroy the eggs or caterpillar, or infestation in any stage, which may be within or attached to them.

In the constant traffic to and fro connected with flour sent from mills, warehouses, &c., to small depôts, especially to bakeries, there is every probability of the range of infestation being constantly increased, and I can speak from personal knowledge of the infestation in bakers' stores being allowed to continue as if it was of no consequence; and whether or not (in the constant replacement of supplies) this matters to the owner, the infested bins and storing places make a constant centre of spread of infestation to returned sacks or bags.

In cases like the above, ordinary methods of purification would be of great service—such, for instance, as use of scalding hot water, applied to floors of bins, and wherever it could be run, as near boiling point as possible, and into all chinks and crannies, which are favourite resorts of the caterpillars; and also thorough lime-washing the walls at frequent intervals with some insect deterrent, such as naphthaline or paraffin, mixed in the wash, is an important point of treatment where the application could not come in contact with the flour.

For mill use, however, some very much more stringent remedies are needed, and at present *nothing is before the public* which answers thoroughly, or to which there is not some objection by reason of its ill-effect, without enormous care, on flour, machinery, or operators. Still, some amount of good has resulted, and I give as shortly as I can the method of application of some remedial measures which have been partially successful.

The first experiment tried (subsequently followed up on an enlarged scale in Canada) was in 1888 in steam mills in the north of England. Here I suggested the possibility of getting the infestation under by *turning on hot steam* from the engine, a plan which I knew had been perfectly successful in clearing a cheese factory of maggots which had spread into chinks and crannies to a very troublesome extent. My correspondent, acting on the suggestion, "stopped the mills for a week, and had all the machines cleaned through, and then *went over them and the walls with steam*, and then whitewashed the walls and *underneath all floors* with fresh-slaked lime and paraffin." He noted that the way he applied the steam was by carrying about forty yards of half-inch piping into the mill from the boilers, and attaching an indiarubber bore to it for the men to work about on the walls, floors, spouts, and machines, blowing the steam into all the crevices and holes. "After blowing the steam, which took two or three days, I set," he reported, "the men to work to wash the walls (and everywhere that they could without fear of affecting the flour) with paraffin; inside the machines I had washed with a strong solution of boiling water and soda. I find that strong soda and water is effectual in destroying the maggots when it can be got on them. I still continue washing and *syringing* all likely places for them to settle with paraffin, and keep a lad or two going about brushing up and killing all the moths they can see."

The result of the above was reported to be, though not a positive clearance of the pest, yet there were comparatively few moths about, and he hoped that their continual exertions would prove successful.

This steaming rusted the shafting, &c., but this was said to be quite a secondary matter, as it could soon be cleaned again; and further, where flour in sacks, &c., is so placed as to be exposed to action of the steam, it is as matter of course damped. But where this trouble is provided against, the steaming treatment appears (though not a complete remedy) to lessen the evil to a very serviceable amount.*

Consequently on our English experiments, and after much consultation of the entomological authorities in the province of Ontario, Canada, on the first appearance of *E. kuhniella* there in 1889, careful measures of purification by steaming, &c., were set on foot in the steam mills where this mill scourge had established itself, which were detailed as follows †:—

"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."

These measures of purification, however, effective as they appear, were not considered to be sufficient, and an Order in Council on the subject was passed on Sept. 19th (1889), approved of by His Honour the Lieutenant-Governor, and an order was given to the steam millers that, before placing the machinery in position, it should be subjected "to a thorough disinfecting process in a strong room so arranged that steam under pressure might be drawn or driven into it."

"In compliance with this order," the millers reported, "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 the process was going on, and pronounced it a success. This was all done, not only in our own interests, . . . 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, . . . we have arranged for remedial measures to prevent the re-appearance, or for the destruction of the pest should we ever be again attacked. We have erected a steam stand-pipe, with hose or

* See my Annual Report for 1888, p. 70.

† See 'Bulletin 1, Provincial Board of Health of Ontario': "The Flour Moth, *Ephestia kuhniella*." Issued by the Ontario Department of Agriculture.

other connection, on each flat of the mill building. By shutting up all doors and windows on each flat, and turning on the steam simultaneously to each floor, the whole building can be filled with live hot steam sufficient to kill anything."

In a letter written to myself by the owners of these infested Canadian steam mills (a part of much correspondence which passed between myself and Canada on the occasion of the attack), the loss up to Sept. 29th was stated to be about £1000.

By the above measures, modified, of course, to suit the requirements of different mills, the presence of infestation can be got under; but still there follows the almost absolute certainty that it *will reappear*, unless the most stringent measures are taken to prevent this under the superintendence of someone well acquainted with the infestation, and the signs of its presence in flour. The masses of spun-up material which are *the* trouble in this attack are well described by one of my correspondents as caused by a web or tissue, "which links, or rather gathers together flour and other stock, forming a sponge, which sometimes assumes such proportions that spouts are actually blocked up. They are also a trouble at the feed-rollers, as they make the feed to roller mills and other machines uneven, and might at such an injury do vast injury to the plant."

So far as I am aware, the only method of making a complete *clearance* of the pest out of an infested mill, without almost prohibitory amount of expense and trouble and publicity in the operations, is FUMIGATION.

One great advantage of this treatment is that the fumes penetrate into every cranny, and so reach the pest in its sheltering places, where no mechanical measures would penetrate to it. But, on the other hand, the treatment may greatly injure the flour left within sphere of its action, or, again, may be dangerous in the extreme from inflammability.

One plan recommended in the Canadian Bulletin, previously quoted, is to subject the affected portions of a mill or building to repeated treatment with the fumes of burning sulphur every night when the works stop. If this is persistently carried out, it is stated that little development of new forms (presumably continuation of development from caterpillar to moth—E. A. O.) will follow; but it is also stated that abundance of sulphur must be burnt again and again to ensure success.

The effect, however, of the sulphur on the condition of flour stored where it is exposed to its effect has been found to be so destructive to its suitableness for bread making, that I subjoin a report received from the owner of some large steam mills as a caution to those not acquainted with the disasters that may arise.

In this case, after sulphuring had been used on a scale *of great strength*, it was noted:—"We found that the sulphuring had an effect which we did not anticipate or wish for. We had standing in the mill itself when the fumigation was carried out some eighty or one hundred sacks of flour, and we find to our dismay that the sulphur has penetrated right into these, and acted on the gluten of the flour in such a manner as to apparently break it up into soluble albuminoids, and render the dough made from it more like a lot of weak putty than the strong tough dough our customers require. The effect would be very disastrous to millers who store their flour in the same building as they manufacture it in, as some do, and in our case it has given a lot of trouble. I think you will be glad to know of this, that you may warn your correspondents against sulphuring any building containing large quantities of corn."

I particularly beg my readers will notice the above, so that the sulphuring, where carried on, may be without danger of injury, excepting to the caterpillar-infested flour; and with this caution I give what appears one of the safest methods of creating sulphur fumes noted in the Canadian Bulletin:—

"To prepare sulphur fumes.—Place a *metallic* dish containing hot ashes on some support in a pan of water, or place it in an old pan or other vessel, a bed of ashes at least six inches deep, and about fifteen inches in diameter, and place the sulphur and saltpetre in a slight depression in the centre and ignite.

"The proper proportions are three pounds of sulphur and three ounces of saltpetre per one thousand cubic feet of air space. All doors, windows, and other openings should be tightly closed before the sulphur and saltpetre are ignited."—(Page 12 of Canadian Bulletin 1, previously referred to.)

"Chlorine fumes may be used with equal benefit under those conditions where burning sulphur may create an added element of danger from fire.

"*To prepare chlorine fumes.*—Mix in a glazed dish and place on a stove or other heating surface peroxide of manganese one part, sulphuric acid two, chloride of sodium three, water two; or more easily by mixing three pounds of chloride of lime and three pounds of hydrochloric acid for every one hundred feet of space."—(Page 14 of above Report.)

I give the above recipes *by no means on my own authority, but as advised* on what I believe to be by the thoroughly trustworthy recommendations of the Canadian (Ontario) Government in the Bulletin frequently referred to (*ante*). But I would most earnestly suggest to all millers and others connected with preservation of stores of flour that, before using these or other *chemical* remedial measures, they should (unless they are themselves acquainted with the effects on flour constituents) lay the matter before the chemist of their firm. This is especially to be considered in the case of the following application.

Bisulphide of carbon.—This as a fumigant is, I believe, the application recommended above all others in America as successful in clearing out "Mediterranean Mill Moth" and other insect pests of stored goods (as of Beans or Peas, for instance) on which it can be brought to bear in confined areas, large or small. From the widespread prevalence of its use for many years, it is presumable that it can be used safely with ordinary care, but as yet its use has not gained footing here, and *I could not think of recommending its use myself, excepting under the advice and direction of a known trustworthy chemist.* Therefore, I do not give any recipes for the method of application. The danger is great in uninstructed hands of its excessive inflammability, causing disaster in all directions; it not only ignites from presence of light in its neighbourhood, but also at a raised temperature unaccompanied by neighbourhood of light; also its effect on the workers exposed to the vapour, before the mill is ventilated, may be prejudicial in the extreme.

Observations.—In the above pages I have endeavoured to give a digest, to the best of my power, of the main points which have been recorded regarding this destructive flour pest, since it came under notice some thirteen years ago, including in this—detailed description of its appearance and of its habits; its geographical distribution; *preventive measures* both requisite and easy of application to an extent to very considerably lessen amount of its presence; and remedial measures which appear to me to be at the best temporary in their action, very costly, very troublesome where consisting of mechanical treatment, and where of chemical treatment involving risk of many kinds.

These abstracts of observations, ranging over thirteen years, I have arranged from reports sent from millers in this country to myself, sometimes *in extenso*, sometimes giving the subject of their communications; also from the foreign and American works of authority on the subject; and, looking at the whole matter practically, it seems to me that the best that can be done, as shown by our own plain common sense, and those points most especially dwelt on in official reports are *keeping out the pest* so far as may be done by:—

Firstly, refusing all infested consignments of flour, great or small, from cargoes downwards.

Secondly, where there may be suspicion, quarantining the flour *apart*, so that no evil may spread from it until it is found whether the *pinkish Ephestia* caterpillars are present, or moths develop.

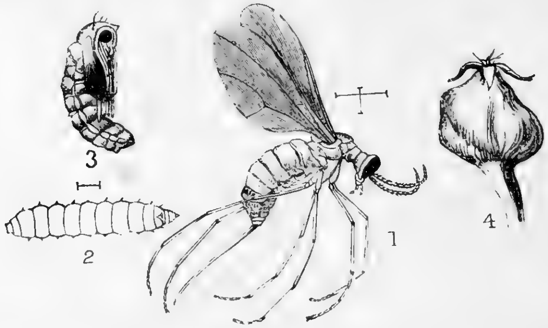
Thirdly, the vitally and enormously important point of regularly disinfecting sacks, or bags, used in transmission of flour to and fro from mills, warehouses, bakeries, &c. This in itself would greatly lessen infestation.

Fourthly, "cleanliness," as it is described; *i.e.* frequent washing of walls and every possible surface with whitewash, mixed with paraffin, carbolic acid, or any ordinary insect deterrent.

All these would help, and, while I trust that I have verified all the points suggested so carefully that I may not be thought presumptuous in bringing them forward for consideration, I should like to add that I should be truly grateful for any corrections or additions which I might be kindly favoured with, to help me to be of greater assistance in the severe cases of infestation, in which, under promise of business confidence, my suggestions are applied for; or (if desired) for preparing a leaflet for gratuitous distribution.

PEAR.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra ?*, Meigen and Schmidberger; *C. pyricola ?*, Nordlinger.



Diplosis pyrivora.—Female, magnified; lines showing natural size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

It will be well in the remembrance of many Pear growers, that in the year 1898 the attack of the maggots of the Pear Gnat Midge was more prevalent (especially in the midlands and more southerly part of England) and more seriously injurious to the young forming Pears than in any year since 1883, when the attack was first entomologically recorded as present, although not to any serious amount in this country.

In the following year, that which is just past—namely, 1899—

scarcely any enquiries were sent me regarding the infestation, and it would not have been worth while to enter on the subject again excepting that from this very circumstance (of *non*-observation), it appeared of serviceable interest to ascertain whether the attack recurred at the localities at which it had been reported as noticeably injurious in 1898; and if not, to what circumstances or what preventive measures the non-reappearance might be ascribed.

Through the courtesy of my correspondents, who are all well qualified to report on the subject, I have been furnished with the information requested, which I give (p. 94, and onwards), appended in each case to a note of some of the points of appearance in the preceding year, and I trust it will be considered, on glancing over the summary following the notes, that we have now quite sufficient practical information before us to enable us to keep the attack of this Pear Gnat Maggot (*Diplosis pyrivora*) in check.

The Gnat, or Midge, which causes the injury is a very small two-winged fly, gnat-like in appearance, and about the twelfth of an inch or rather more in length (see figure, magnified, and lines giving natural length). The general appearance is greyish or black, but, when examined in detail, the head is black, bearing a tuft of yellow hairs; thorax black, but with some grey markings, and varying in appearance according as to whether it is looked at from before or behind. A tuft of yellow hairs placed at the root of each of the dusky wings, which are clothed and deeply fringed on the hind margins with black hairs. Abdomen dark brown, clothed with long whitish hairs; legs brown, clothed with white hairs, more dense on the upper surface.*

The method of egg-laying is considered to be that when the Pear blossom-buds are so far advanced as for a single petal to show itself, the Pear Midges deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud; but they have been recorded by one observer as egg-laying in the open blossom. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and devour in different directions.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail. Within the young (or it may be said the embryo) pears the midge maggots live and feed until they have attained their full size, which may be about the beginning or middle of June, and the infested Pears may often, though not always, be known by their knobbed irregular growth and discoloured patches.

* For full and clear description of the imago or perfect Gnat Midge of *D. pyrivora*, see paper on this insect by R. H. Meade, in 'Entomologist,' vol. xxi.

At this stage—that is, when the young Pear is destroyed by the mischief within—the fruit usually cracks or falls to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or, if it falls without cracking, may remain for some weeks within. In either case they bury themselves in the ground, and (quoting from Prof. J. B. Smith; for reference, see note below) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring." There appears to be a difference of date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come out of the ground in spring ready to attack the blossom-buds of the Pear.*

On the above points in the life-history—that is, in the circumstance of the maggots falling to the ground from or in the fruit, and burying themselves a very little beneath the surface, where they go through their changes to the perfect Gnat-fly—the preventive measures almost entirely turn.

These mostly consist in gathering the injured fruit before the maggots are arrived at the stage at which they leave it, and *destroying* maggots and little Pears together; also of skimming the surface of the soil beneath infested trees and removing it, and burying it down or otherwise destroying it, so that the maggots within may be certainly destroyed; or dressing the surface with some application (preferably with kainite) which has been found serviceable in preventing development of the maggots.

Practical notes of the effect of this, and of some other points of treatment will be found in the following observations, and are given in the successive order in which requests for information, with specimens of the Pear Midge maggot accompanying, were sent me in 1898, thus (taken together with the reports of 1899, appended *seriatim*) affording a usefully interesting view of the effect of such preventive measures as were carried out.

On May 13th, 1898 (the earliest date of enquiry as to attack then in active stage sent me), I received the following enquiry from Mr. H. H. Williams, of Pencalenick, Truro, Cornwall:—

"Could you kindly tell me if it is possible to prevent the attacks of the insect which has got into the young Pears I enclose? Last

* See, for much useful information on this attack, "The Pear Midge (*Diplosis pyrivora*, Riley)," Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

year I picked and burnt all diseased fruits, and this year it does not seem quite as bad. I noticed that one lot of trees which was heavily limed on surface (quick-lime) last autumn have not suffered nearly as much as another lot which were not dressed with lime."

On May 16th, 1899, in the past year, Mr. Williams was good enough to forward me the following notes, with specimens again accompanying, as confirmatory of the attack being certainly that of *D. pyrivora.* It will be seen from the observations that the amount of attack was very much lessened by the treatment of dressing with kainite, and of picking and destroying all diseased Pears.

"I am glad to say that, owing to carrying out your advice of last season, as to using kainite around infested trees, and ruthlessly picking and burning all diseased fruit, the attacks this year have *very much* diminished, and I hope by next season to almost stamp out the pest. I note one remarkable coincidence every year—that 'Louise Bonne of Jersey,' which is our earliest bloomer here, practically escapes altogether, while two of the latest to flower—'Pitmaston Duchess' and 'Williams' Bon Chrétien'—always suffer the most. This would seem to show that the midge can only operate on fruits at the very earliest stage of their existence. I have again noticed the almost entire immunity of trees on walls, no doubt owing to earth around them being kept well hoed, and so always on the move in summer."—(H. H. W.).

"P.S.—I have just had a look over two trees side by side, both of which promise a good crop; on one of them, 'Louise Bonne,' I gathered only two infested fruit, while on its neighbour, 'Pitmaston Duchess,' over fifty diseased Pears were picked. The former tree flowered fully a fortnight earlier than the latter."

On May 16th, 1898, specimens showing attack of this Pear Midge—that is, of *Diplosis pyrivora*—were sent me by Mr. H. F. Getting, from The Gardens, Glewstone, near Ross-on-Wye, Herefordshire, requesting information as to the cause of the small brown or dark velvety-looking spots on the small Pears enclosed.

It will be seen from the following reply to my enquiries which Mr. Getting favoured me with on Jan. 5th, 1900, that it was considered too late in the season to apply the kainite, and lime was tried instead, which appears not to have had any deterrent effect. It is worth notice, in this as well as the preceding note, that "Pitmaston Duchess" is reported as a kind of Pear peculiarly liable to this Midge Maggot attack:—

"I reply to your questions to the best of my ability.

"*Diplosis pyrivora.* When you kindly gave me some advice in 1898 how to deal with this pest, it was too late to apply kainite. Therefore, I thought I would give a heavy dressing of hot lime in the winter, which I did.

"Last spring (1899) the Pear Midge was worse than ever, both as regards further varieties it attacked (among these notably the Duchesse d'Angoulême, which in 1898 was scarcely touched, and in 1899 nearly all were), also as regards number of maggots in a single Pear—in many cases I counted as many as twenty.

"Last year (1899) in good time I applied a heavy dressing of kainite, and shall watch with great interest result on a row of the Pitmaston Duchess, which were about the worst attacked, and at same time finest trees in the plantation. . . . . I also heard from other sources that the Pear Midge had been very destructive in some parts of Herefordshire last year."—(H. F. G.)

Early in the year 1898 I received a communication from Messrs. R. & B. Bomford, of Pitchill, near Evesham, desiring information as to measures of prevention, in the (then) coming season, of an attack to very young Pears, which, from the clear account given, was obviously that of this Pear Maggot, *Diplosis pyrivora;* but on May 30th following Mr. Benjamin Bomford again communicated with me from Evesham, with specimens, leaving no doubt as to the nature of the attack:—"I have delayed writing to you respecting the Pears, hoping to have a better report to send from the late blossoms, but I am sorry to say we have a complete failure again this year." The specimens, consisting of five bunches of little Pears, of which the largest were about five-eighths of an inch across, and a little more in length, showed characteristic infestation to a serious extent.

From Mr. Bomford's accounts of the attack of 1899, sent me June 2nd, 1899, and Jan. 8th, 1900, it will be seen that the attack was *much* the worst on the pasture land, and that where the land *was dug*, which would act to some degree similarly to scraping off the maggot-infested surface and destroying it there, was *not a very bad attack.* No marked different effect was observed consequently on application of kainite, nitrate of soda, or of gas lime.

June 2nd, 1899:—"I posted you yesterday two branches of William Pears—the one was the worst I could find, and the other one of the best. On the one I do not think you will find a single sound Pear, but on the other there are about five. The attack is much worse on the pasture land; both these were taken from it; where we have dug the land we have not a very bad attack this season, but unfortunately the Pears have not set well there."—(R. & B. B.)

On Jan. 8th, 1900, Messrs. Bomford further communicated with me:—"In reply to yours of the 2nd. As we stated in ours of June 2nd, the attack of Pear maggots in 1899, although very severe, was nothing like so bad as in 1898, when our entire crop was destroyed. Last year we had about a third of the crop left. We tried, as you suggested, kainite and nitrate of soda, also gas lime later on in the spring, when the maggots were falling; but we cannot see any marked effect from either, as the attack was uniformly less on all the trees. We will watch them carefully again this season, and let you know if there is any marked effect from either treatment."—(R. & B. B.)

On June 6th, 1898, I was favoured by a communication from Mr. Geo. Brown, Gardens, Bowood Park, Calne, Wilts, relatively to the nature and means of prevention of an attack to young Pears, of which samples were sent accompanying, and by which very many of the Pears were said to be infested. This attack was also of the Pear Gnat Midge, *Diplosis pyrivora*, and showed bad infestation in an advanced stage, the season of the duration of the attack now drawing to a close, and the maggots leaving the destroyed young fruit.

Of about thirty or more Pears sent me (all of which I opened), I found all excepting one were infested. In many cases the attack had been completed, and the maggots gone. In most cases a great part of the inside of the Pear was hollowed out, or decayed, consequently on the attack. The decayed part sometimes reaching across the Pear, and often making a damp, quite soft, decayed condition on part of the side of the Pear through which it was presumable the maggots had made their escape. Some, I found from examination, might very probably have escaped by the communication of the infested decaying and gnawed portion of the inside of the Pear with the opening at the calyx end of the Pear. The maggots appeared to be mostly fully grown, and I counted their numbers up to about six and twenty in two of the Pears which I examined. They were very active, and their skipping powers were very noticeable as they dispersed on the dark red and black tablecloth of my study table.—(E. A. O.; June 7th.)

On Jan. 12th, 1900, Mr. Geo. Brown was good enough, at my request, to place in my hands the following note of the results in 1899 of his careful treatment applied in 1898—namely, of gathering and destroying infested Pears, of skimming off and destroying surface soil around infested trees, and also of dressing heavily with kainite and also with wood-ashes. The result, it will be observed, was that, although the attack again made its appearance, yet "it was not to such an alarming extent as in the previous years."

"The Gardens, Bowood Park, Calne, Wilts, Jan. 12th, 1900:—I have much pleasure in complying with the request contained in your letter of the 3rd inst., and now try to append the information you ask for regarding the infestation of young Pears by *Diplosis pyrivora*. In June, 1898, you were good enough to recommend to me a means of destroying this pest, which I accordingly carried out—

"1st. By gathering and destroying all the infested Pears.

H

"2nd, By skimming off the surface soil round the trees, and removing it to a distance, where it was deeply buried in a pit; and

"3rd. By dressing the ground heavily with kainite, and also with wood-ashes.

"Last year the gnat again made its appearance, but not to such an alarming extent as in the previous years, and I again adopted the treatment named in the first two paragraphs above; but, lest a second application of kainite might have an injurious effect on the roots of the trees, I withheld that.

"This winter I am trenching the ground under the trees as far as practicable, being careful to have all the surface soil where there may be any of the larva deposited, to a depth of several inches, removed well into the bottom of the trench.

"By following this treatment I hope in time to be successful in exterminating the pest."—(G. B.)

On June 9th, 1898, notes showing presence of severe attack of the Pear Midge maggot on trees where there had been some small amount of infestation in the previous year, were sent me by Mr. F. W. Thomas, from Wannock Gardens, Polegate, Sussex, with specimens accompanying; showing (as in the preceding observation) that at this date the *D. pyrivora* larvæ were leaving the Pears. On June 13th Mr. Thomas further wrote, "I have done as you suggest, and have gathered all the fruit I find affected."

On Jan. 5th, 1900, in reply to my enquiry as to result of treatment, Mr. Thomas favoured me with the following reply, by which it will be seen that he followed up removal of the diseased fruit by application of kainite, and that the result of this treatment in 1898 was that in 1899 he only found six dozen fruits attacked. Mr. Thomas wrote as follows:—

"In reply to yours of the 2nd inst. *re* Pear maggot, I am pleased to tell you I followed your advice and dressed the soil around the Pear trees with a good strong dressing of kainite; this was done in July, 1898. Last year I only found six dozen fruits attacked, which I carefully picked and burnt. It was not at all a good year for Pears in this district, but I noticed that all the fruits attacked were Williams' Bon Chrétien, and Beurré Hardy; Souvenir du Congrès, which are planted in the next rows, quite escaping.

"Thinking to be on the safe side, I again gave a dressing of kainite to those trees which had the fruit attacked in July; I am afraid I gave it too strong to one tree, as I noticed towards the end of the summer the tree looked as if it was going to die, and on examining the roots a short time ago I found all the fibrous portions dead. It is only the earlier kinds of Pears that have ever been attacked in this garden."

On June 16th, 1898, the latest date of observation of attack which was sent me, some samples of little Pears affected by the Pear Gnat Midge were forwarded me by Mr. J. Lansdell, F.R.H.S., from The Gardens, Barkby Hall, near Leicester, with the information that the Pear crop was suffering severely from the pest, and enquiries and observations sent accompanying showed that it was a newly noticed trouble. It will be observed that Mr. Lansdell ascribes the immunity from attack noticed in his reply to my enquiries to be certainly in part attributable to the fact that in 1898 *every* affected fruit which could be seen was carefully gathered and burnt.

On Jan. 6th, 1900, Mr. Lansdell, now Assistant Horticultural Instructor for Worcestershire, replied to my enquiries regarding result of treatment from Pomona, Wyld's Lane, Worcester:—

"With reference to *Diplosis pyrivora* at Barkby during the past year, the attack has been very slight. Unfortunately I did not take note of the exact number of affected fruit, but it would only be about nine or ten.

"I considered the immunity of attack was from two causes. (We had no standard Pear trees.) All were on the walls, or as bushes, so that the trees could be easily watched, and every affected fruit in 1898 (which could be seen) was carefully gathered and burnt. 2nd. In the spring of 1899 we had a splendid show of bloom on all our Pears, but, owing to the severe frosts, the crop was a light one in comparison to the large quantity of blooms, and I considered there might be an enormous loss of eggs of the *Diplosis* in these dead blossoms."

Summary of the above.—Gathering and destroying infested fruit has had very good results; so has removal of the infested surface, or digging it in; and this stands in contrast to conditions of trees on pasture land (see p. 96), where, of course, the infested surface could not be removed.

Kainite, so strongly recommended in U.S.A. practice, has answered well; and there is a good note of successful use of wood-ashes. No special benefit appears to have followed use of lime or of nitrate of soda. A few notes are also given of kinds of Pears which are considered less or more subject to infestation, with some remarks on what is conjectured to be the reason of this circumstance.

PREVENTION AND REMEDY.—The following are the main points to be attended to, put as shortly as possible. The little maggot-infested Pears, which may be very fairly distinguished by their stunted, lumpy growth, and greater or lesser amount of black spots or patches, should, if possible, be picked from the trees before the maggots leave them to go down into the ground, and should be burnt or otherwise carefully destroyed. On no account merely thrown aside.

If the diseased little fruits can be shaken down, this saves much trouble; but in this case it is desirable that they should be shaken down on to some material spread below, so that Pears and maggots may be gathered up together, and thrown into a deep hole (where they can be safely buried away) or on to a fire. A sticky material is the best for shaking down on, as the maggots have good leaping powers, and, unless prevented, may get away.

Where the trees are not growing in grass, and the ground beneath them is free of crop, and also the Pear roots not too near the surface, the plan of skimming the surface, and destroying the surface earth with its contained infestation, would answer well. The depths given for presence of the cocoons are half an inch to two inches, and this might (I believe) often be safely removed. Any time would be suitable for this operation between the time of the falling of the infested Pears from the trees, and such a date in the following winter or spring as would ensure that the cocoons should be skimmed off and destroyed in the infested earth before the season came (or rather, drew nigh) for the appearance of the Gnat Midges, which takes place with that of the Pear blossoms.

Where digging is admissible, this, if properly carried out, is serviceable (see p. 98); but if the operation only consists in breaking up the surface, as in the common method of digging, it is not likely to do much good. The infested earth should (as noted) be carefully buried away.

The best application to use for dressing appears, both from the published experiments of Prof. J. B. Smith (see note, p. 94), and also from our own trials, *to be kainite.* With regard to amount given in an experiment on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown, fifty per cent. were "midged," and of the other kind named not one could be found to have escaped.

But in the case of sprinkling with a small quantity of kainite, in laboratory experiment, only three per cent. of living larvæ were found in the cocoons examined; and where double quantity was used, "not one-third of the larvæ in the jar had ever formed cocoons, and those that did seemed all of them to be dead."

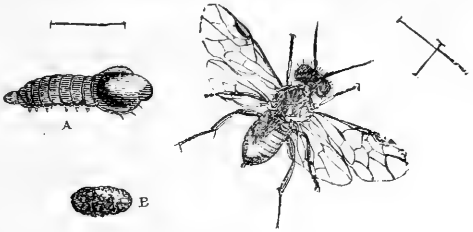
Also, in laboratory experiment, Prof. Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand in which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of nitrate was applied, a still lesser proportion of the maggots were found to be alive.

Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons.

I am not aware of the action of lime having been tried, but the experiments are given in minute detail in the Bulletin referred to at p. 94.

In our own (preceding) horticultural reports of experiments, it will be noticed that various kinds of Pears are named as subject or not subject to attack, which may prove to be serviceable information; and I offer my best thanks to my contributors for their kind courtesy in allowing me to give my readers the benefit of their skilled practical observations.

Pear and Cherry Sawfly. *Selandria atra*, Stephens and Westwood; *Eriocampa limacina*, Cameron; *Eriocampoides limacina*, Retzius.



SELANDRIA ATRA.—A, "Slugworm" of Sawfly; B, cocoon—both much magnified; Sawfly, with lines showing natural size.

The infestation of the Pear and Cherry Sawfly, figured above, has been known for more than a hundred and fifty years as injurious to leafage of various kinds, and especially to that of Pear, Cherry, and some other kind of fruit trees by means of its small, slimy, Slug-like, blackish, or bottle-green caterpillars feeding on the upper sides of the leaves until, in cases of severe attack, nothing is left but a network of veins held together by the skin of the under surface of the leaf.

In some years, as in 1896, the infestation has been widespread, and caused a great deal of damage; but, so far as reported, it never reaches the height, in this country, of being one of our great fruit pests, and with moderate care (since its life-history has been known) it can be kept well in check. In the United States the attack is much more injurious, both by the virulence of the attack itself, and also by the abundance frequently occurring of presence of the second brood. The identical nature of the American with the European infestation has been proved by careful examination of specimens. This identification is of some importance, for the most serviceable account, both practically and scientifically considered, which has been recently published is, I believe, that of Mr. C. L. Marlatt, First Assistant Entomologist to the U.S.A. Department of Agriculture.*

All who have studied the subject will be aware of the difficulties arising from multiplicity of scientific names of the insect, and Mr. Marlatt, in his paper referred to below, mentions that in Europe this insect has received at least *nine different specific names*, and has been referred to some *eight genera*. In the two appellations given at my own heading, I have followed the guidance of our European writer, Prof. Westwood, and also given the more recent appellation especially selected by Mr. P. Cameron †; in Mr. Marlatt's paper he gives the attack as that of *Eriocampoides limacina* of Retzius, one of the earliest observers (in 1783) of the infestation, which I have therefore added.

The stage of attack at which the presence of the mischief is usually first noticed with us is during the early part of the summer—as, for instance, about the middle of June—when the little Slug-like grubs may be found feeding, though usually not more in number than three or four, on the upper skin (*epidermis*) of the leaf. This they sometimes clear wholly away, leaving only the network of veins beneath it, and the skin of the lower side of the leaf, which consequently turns brown and dies; and in cases of bad attack, the condition of the growing fruit and the health of the tree are necessarily injured by the loss of leafage. Often, however, the upper surface is only eaten off in patches, but still enough damage caused to draw attention to the presence of the leaf enemy.

The larvæ, or Slugworms, are for most of their lives of the shape figured at A, p. 101, about three-eighths of an inch in length when full grown, somewhat broader and thicker at the fore part of the body, and covered with a blackish or greenish slimy exudation, giving the Slug-like appearance from which the larva takes its popular name.

After feeding for five or six weeks they moult off their slimy coats, and appear as ordinarily shaped caterpillars, buff or yellowish in colour, dry (that is, no longer covered with a coat of slime), and transversely wrinkled. In this condition the *twenty-two* pairs of feet (that is, three pairs of claw-feet, and a pair of sucker-feet on each of the other segments excepting the fourth) are much more easily distinguishable than when they are in Slugworm state, though the pair at the end of

* See "The Pear Slug, *Eriocampoides limacina*, Retzius": Circular No. 26, Second Series, United States Department of Agriculture, Division of Entomology, p. 7. Washington, 1897.

† 'British Phytophagous Hymenoptera,' by P. Cameron, vol. i. p. 224. Ray Society.

the tail is so small that sometimes it has been passed over, and the larva classed as *twenty*-footed.

After the final moult to the yellow-coloured non-slimy state, the caterpillars leave the food-plant, and bury themselves a little below the surface of the ground, where they spin a somewhat cylindrical obtuse-ended cocoon (see fig. 3, magnified, p. 101); this is only about one-quarter of an inch in length, and, from the adherence of the surrounding particles of earth to the silky web cocoon spun round itself by the larva, is very difficult to distinguish from the ground in which it lies. Under common circumstances, the cocoons, as far as I am aware, are made singly in the earth, and at a distance of about from half an inch to two or three inches beneath the surface, but, as mentioned by Mr. Cameron, when the larvæ are very numerous, the cocoons are spun close to each other; and in the course of last summer, in a case in which the conditions of ground did not fully allow of the usual arrangements, some such interesting observations of some of the cocoons being sheltered amongst large Pear roots, and some being formed into clusters composed of several scores, were made by Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, and kindly placed in my hands, that I have pleasure in inserting his notes with three of his series of illustrative photographs (see pp. 105, 106).

Within the cocoons the caterpillars change to the chrysalis state, from which, although some of the Sawflies may develop in the same season, the main brood (in this country) does not make its appearance until the following year; the exact rate of development, and the extent to which the infestation may be double-brooded here, appears to be variable, or at least not matter of certain record.

The Sawflies (see figure, with lines giving natural length, at p. 101) are rather less than a quarter of an inch in length, black, shiny, and rather downy, or pilose, with the horns (antennæ) rather longer than the fore body (thorax); legs black or fuscous, or with the shanks of the anterior and middle legs respectively testaceous and fuscous; from differences of description, the colouring of the legs appears to be variable. The four wings transparent and iridescent, with a smoky band across the middle.

The above are the stages of the infestation most commonly observed, those connected with the egg deposit, which starts the attack, being on such a minute scale as to require a magnifying glass to distinguish the details.

The places of egg locality, as I have occasionally seen them myself,* are to be found in the upper side of the leaf as little spots roundish in

* See 'Observations of Injurious Insects,' by E. A. Ormerod, during 1893, p. 81.

shape and whitish in colour (from the upper coat of skin being dead), slightly raised in the middle, and of a somewhat transparent tint *just over the contained egg*, which was a soft mass, compressible, thick, and somewhat circular in outline. These little white blisters, or patches, of white dead skin *covering the eggs*, were about one-sixteenth of an inch across, and on one leaf where I counted them, over thirty in number, on another there were about twenty-five ; all these (with possibly one exception) showing on the upper surface of the leaf.—(E. A. O.)

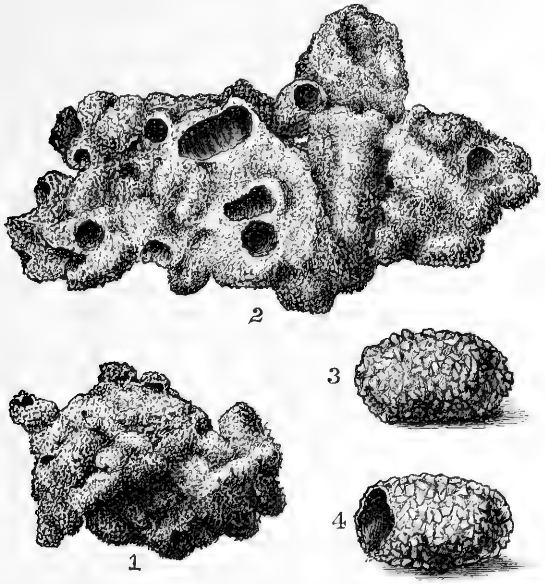
The process of egg-laying, which I had not the opportunity of observing, is thus described by Mr. C. L. Marlatt in his paper on habits of the "Pear Slug," referred to in note at p. 102, *ante*:—"But one egg is deposited in a place, and it is always inserted from the under side of the leaf. The ovipositor is thrust obliquely through the leaf to the upper epidermis, but not piercing the latter, and shows there distinctly through the transparent upper skin of the leaf." [The description is accompanied by a figure.—E. A. O.] "The saw-like instrument, when brought into the position noted, is moved rapidly with a swinging lateral motion from side to side, cutting the upper epidermis free, so as to form an irregular cell or pocket of peculiar flattened ovoid outline. The egg is quickly passed down between the plates of the ovipositor, and dropped into the pocket thus made, the time occupied being a little over one minute for the entire operation. . . . The egg is oval, slightly flattened on one side, and remains in its peculiar cell for a period of about two weeks before the larva escapes."—(C. L. Marlatt : see paper previously referred to.)

Mr. Newstead's description of the egg in his paper, from which I quote at length further on, agrees very nearly with the above :—"Form subcircular, slightly flattened, shining. . . . It is laid on the upper surface of the leaf beneath the epidermal layer."—(R. N.)

In my own observations, taken from specimens sent me on June 14th, 1893, I had the opportunity of seeing the Sawfly larva whilst still in the egg. Most of the larvæ had hatched out, leaving only the white skin cracked where the maggot had effected its escape, but two eggs still remained unhatched. One of these eggs contained the white Sawfly larva curled on itself within, and sufficiently developed to be of characteristic shape—that is, with the largest segments behind the head, and the hinder portion of the maggots with the segments much narrower transversely. In the other egg the contents were not yet sufficiently developed to be defined in shape. I did not see any larvæ in the act of coming out of the egg, but the smallest of them were as a general thing of a yellow colour.—(E. A. O.)

As recorded by Mr. Marlatt, the larva at first is clear or free from slime, and in colour nearly white, except the yellowish-brown head, but almost immediately the slimy exudation begins to form and spread over its whole body, giving the Slug-like appearance from which it takes its name.

The above notes give, in condensed form, the most noticeable points of the habits and method of attack of the Pear Sawfly. The amount of injury and the appearance of the injured leafage (see p. 102) has been so often described that it is unnecessary to notice it again, and the very important point of the capacity of the *larva* or Slugworm for throwing off its slimy coat, and thus getting rid of acrid or irritating dressings which may have been thrown on it, is entered on under the heading of "Methods of Prevention and Remedy" (p. 110).



1, Cluster of about one hundred cocoons, natural size; 2, part of cluster in which the larvæ have bored into the mortar to form their cocoons; 3 and 4, cocoons, much magnified.

Previously to this, however, I give the following notes regarding attack of this infestation to a Pear tree, first observed about five years ago by Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester, which he kindly permits me to make use of, and which I insert *in extenso*, as they enter on many points of much interest to treat of together, and especially as giving instances of the caterpillars under special circumstances, in some instances forming their cocoons on large roots of the Pear; and also, in other instances (from lack of room), placing their cocoons so closely together as to form connected clusters of several scores. The figures above are copied, by permission, from photos taken by Mr. Newstead.

The detailed description of the attack was given me by Mr. Newstead writing, on August 31st, as follows:—"Just five years ago I was asked to inspect a blighted Pear-tree, in the immediate neighbourhood of Chester, which I found to be infested with Slugworms or larvæ of *Selandria atra.* The attack was a moderately bad one, but the tree had not then suffered to any serious extent from the effects of the infestation.

"Since then year by year the insect has increased until now, with the aid of a hot summer, the upper half of the tree has been denuded of its leaves, the result of the work of these black pernicious pests, which have shorn almost every leaf of its upper epidermal layer, making bare the delicate nervures, and causing the leaves to prematurely fall from the tree.

"My advice was to apply a dressing of Paris-green (in proportion one ounce to twenty gallons of water); and in the winter to clear away all surface soil and destroy it. The Paris-green was applied, but to a part of the tree only, and it appeared to have 'little or no effect' (so my informant states) upon the larva. To have ensured success the application should undoubtedly have been given to the whole of the tree, and I now think the quantity of Paris-green might with safety have been doubled.

"There was a difficulty in removing the surface soil, as, with the exception of one square foot at the base of the tree, the whole of the root-area was covered with small paving-stones (water-worn boulders or 'cobbles'), forming part of the stable-yard.

"To remove the surface soil meant also the removal of the stone pavements, which would have entailed great labour, and so the most effectual method of prevention was not carried out. But as a substitute a top dressing of *hot lime* was applied, which, *judging from* the abundance of the pest this year, appeared to have little or no effect upon the larvæ as they descended to spin their cocoons and pupate, or upon the well-protected pupæ in the soil.

"This year (1899) two applications of 'paraffin emulsion' were made, but without the slightest effect upon the 'Slugworms,' and in despair the tree was condemned to the axe, with a view to *planting another in its place.* Before doing so, my gardener friend sought my advice, and I paid a second visit to the infested tree. The upper half had scarcely any leaves upon it; and almost all the leaves that remained were brown and threadbare from the ravages of the pest.

"The greater number of larvæ had gone down to spin their cocoons and pupate, but there still remained a few larvæ *in all* stages, from the newly hatched embryo to the full-fed individual ready to cast its shiny Slug-like coat, and to descend to the earth, there to pass its long winter sleep.

"I felt it was useless applying insecticides to the few remaining larvæ, and that my only course was to *demonstrate* to my applicant the absolute necessity for clearing away the surface soil. I had on no previous occasion dug out the cocoons of this pest, and therefore was not at all certain of the most favourable spot to search for them; but a former experience with the cocoons of the Gooseberry Sawfly (*Nematus ribesii*) enabled me to form an idea as to its nature and the difficulties of finding so comparatively small an object, which exactly resembled a crumb of earth.

"My attention was directed to an examination of the soil between the roots at the base of the tree; this was carefully rubbed between the palms of the hands as being the surest way of finding the loose cocoons in the earth, but none were found in it.

"Noticing patches of apparently loose earth still attached to the bark of the roots, these were carefully removed, and beneath them were found several cocoons *attached to the bark.* Numbers of others were *clustered together* at the bifurcations of the roots; and further away others were more isolated. Nothing could be more interesting than the wonderful way the cocoons resembled the colour and irregularities of the bark, and when fixed in a crevice it was impossible to detect them without probing and rupturing the cocoon. Portions of the bark bearing the cocoons were removed and photographed (fig. 1, p. 105).

"My attention was next directed to the crevice (about an inch wide) between the stone pavement and the wall; three of the stones were removed and the *soil adhering to the wall* carefully examined. To my astonishment I found this a compact mass of cocoons, some of them old and empty, others containing the newly imprisoned larvæ, changed in form to a short almost cylindrical-shaped insect of a pale yellow colour, and apparently quite inert. The gardener, who had watched my proceedings, was simply astounded at the discovery, and could scarcely believe they were the recent enemies of his ill-fated Pear-tree.

"I continued my search along the wall, exposing in all about twelve linear inches, and from so small an area (say eighteen cubic inches) I got about eight hundred cocoons. They were all cemented together in masses, and so firmly attached to the wall that I successfully cut away portions of the brickwork with the cocoons still attached (fig. 2). None of the cocoons occurred at a greater depth than one and a half inches, while those near the surface were barely covered. While removing the cocoons several specimens of the perfect insect were liberated; they were very active, and ran about the soil seeking a hiding-place, and making every effort to escape, but, strange to say, did not attempt to use their wings; the sun had gone down, and this may account for their reluctance in taking flight.

"This discovery set me wondering whether these insects would have hybernated in the soil through the winter, or whether they would have escaped on the morrow to lay another batch of eggs upon the tree.

"Early on the morning of the following day (Aug. 22nd) I paid a second visit to the infested tree in the hopes of clearing up this interesting question. It was just ten o'clock, and the sun fully ablaze upon the tree, and the Slugworms reflecting the rays of light, like beads of highly polished jet or glass. There, almost immediately in front of me, on a young tender leaf, sat a female Sawfly, evidently enjoying the hot sun. I believe now she was in the act of laying an egg, but in my anxiety to procure the specimen I did not wait to see, but immediately 'boxed' it. Not another specimen was to be seen, and no wonder, as all the cocoons had been removed and destroyed. Miss Ormerod's description of the egg* enabled me to find a number of them, especially on the younger leaves, and sitting alongside of one of them was a newly hatched larva ('Slugworm'), and one of them which I subsequently dissected (see description of egg) appeared to have been recently laid.

"By the foregoing observations we have established the following important facts:—

A. The existence of the insects in all stages in August.

B. The exact position of the cocoons in the earth.

C. The effects [or rather the non-effects] of a top-dressing of hot lime.

D. The apparent uselessness of an application of paraffin emulsion.

E. The result of a *partial* application of Paris-green.

"It may be well to discuss these points under their different headings.

"By the existence of the perfect insect in August we may safely infer the species is at least double-brooded. My friend here says there are two distinct broods of the 'Slugworms'; the first appearing in late May and early June, the second in August. In support of this, Miss Ormerod (Annual Report for 1893, p. 82), quoting the observations of Mr. Cornford, of Etchowe, Lansdown Road, Cheltenham, says, 'the second brood is now *en évidence* about six weeks after the first,' which Miss Ormerod (*loc. cit.*) thought 'attributable to irregular date of pupation.' Writing later (Aug. 13th) Mr. Cornford said of the larvæ, 'they are still appearing on the trees, from the smallest to the full-grown size.' Thus the evidence of the two observers practically agrees, and it is just possible that the first brood of larvæ produce perfect insects in August, and will account for the specimens I have obtained here.

* See 'Report of Observations of Injurious Insects for 1893,' p. 81; also *ante* p. 104.

"Judging, however, from the occurrence of the eggs, larvæ in all stages, pupæ, and perfect insects at one and the same time, I am inclined to think that, like the Gooseberry Sawfly (*Nematus ribesii*)—in favourable seasons at least—there is a succession of broods from May till October.

"The exact position of the cocoons in the earth is of importance as giving us the amount of surface soil to remove, and also the particular places to which we should direct special attention—*viz.* the wall below the surface of the soil, and the bark of the larger roots at the base of the tree (*see* 'Methods of Prevention,' below).

"The application of hot lime as a top-dressing certainly appears to have had no effect upon the pest. It was applied about twelve months ago, and now forms a thin hard layer between the stones; one would think it sufficiently hard in places to prevent the larvæ now getting through it, or the *imagines* finding their way through it after escaping from the cocoons; but one fragment of the lime which I successfully removed has a boring completely through it, as well as through a layer of cloth (an old 'shred' with nail attached) which had fallen into the lime while in a plastic state.

"I can offer no comment upon the application of paraffin emulsion, only that my friend fully assured me that it had not the slightest effect upon the Slugworms. I fully believe, however, that, had the application of Paris-green been applied to the whole of the tree, and the strength doubled, it would have had the desired effect.

"*Methods of Prevention.*—Remove surface soil three to four inches deep all along the wall beneath the infested tree, to a little distance beyond the longest branches, and to about eighteen inches distant from the wall; also expose all the larger roots at base of tree. Scrape and carefully remove all adherent soil, &c., from the wall and the roots and root-forks. A trowel or 'hard chisel' is suitable for scraping the wall, and a blunt piece of wood suitably shaped should be used for scraping the bark of the *largest* roots. The scrapings should not be allowed to fall to the ground, but collected as they fall, and all should be destroyed by fire; on no account should they be thrown to the rubbish-heap. To ensure success, paint the *wall* with pure paraffin, and the roots with a soap-wash applied with a stiff brush. Give a top-dressing of suitable soil to replace the surface soil removed. The above rule applies similarly to the surface soil; this also should be subjected to the action of fire, or buried in a deep hole, in order that the pupæ may be destroyed."—(R. N.)

I have given the above notes *in extenso*, as Pear trees against walls are so liable to be attacked by the so-called "Slugworm" that the minute details of what may be happening in many instances is of interest practically, and several of the points are well worth record.

The observation of the larva being able to work its way through material of such very different nature as mortar and cloth-shred is of interest. The circumstance of kerosine emulsion failing in effect was, I conjecture, attributable to the power possessed by the "Slugworm" of moulting off its protective coat of slime (together with the irritating dressing). For this reason it is necessary to watch the effects of any remedial application, and in case it is moulted off it should be renewed as soon as possible. If much time is allowed to elapse between the dressings, the larvæ will have regained their power to produce the slimy condition, and in all probability the second application of dressing (wet or dry) will be moulted off like the first.

Strong soapsuds, well syringed at the infested leaves, have long been found a useful application with us.

In Mr. Marlatt's 'Bulletin,' referred to previously (page 102), he mentions a simple soap solution or an arsenical wash, sprayed on the plants, as the best means of destroying the larvæ. The soap-wash (it is mentioned), "to be effective, must be applied at a strength of one-half pound of soap to a gallon of water, first dissolving the soap, preferably whale oil, by boiling in a small quantity of water." . . . . "The plants may be sprayed with Paris-green or other arsenical wash at the rate of one pound of the poison, mixed with an equal amount of lime, to two hundred and fifty gallons of water."—(C. L. M.)

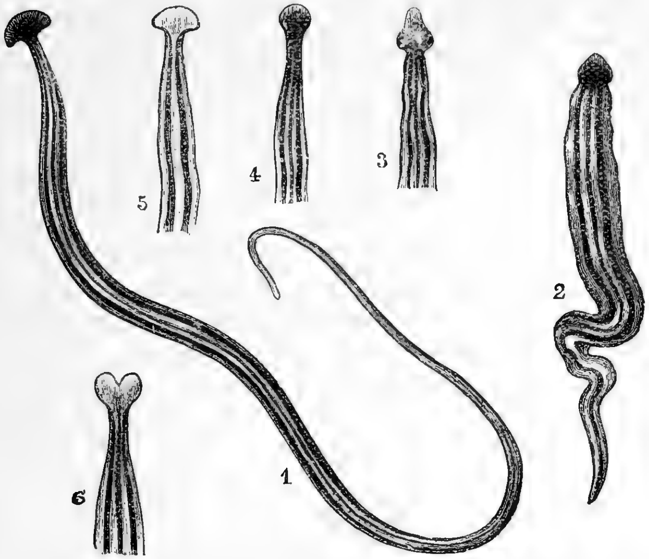
The amount of the Sawflies themselves which are present on the leafage may be lessened by jarring or shaking the infested boughs; but, when fallen down, though they may remain for some time motionless, they will subsequently cease feigning to be dead, and fly away, so that it is desirable to beat them down on to boards, or anything that is convenient to use, which has been tarred on the surface, and thus destroy the flies before they escape.

One of the simplest and at the same time most thoroughly successful applications that I am personally acquainted with is, dusting the Slugworm-infested leafage with a mixture of soot and lime. I have found this to answer perfectly in my own garden in killing the grubs, without any repetition of the treatment being needed; only, if the weather is dry, it is well to give the leaves a good syringing over in a day or two, to clear them from the powder.

Skimming, or removing the surface of the infested ground to the depth at which the cocoons lie, and removing and burning or deeply burying earth and grubs together, is an obvious method of preventing much recurrence of attack; and with a very moderate amount of care this kind of infestation lies so much under the power of *remedial* as well as *preventive* treatment, that in this country at least it need not cause much injury.

PLANARIAN.

Land Planarian; "Flatworm." *Bipalium kewense.*



BIPALIUM KEWENSE.—1, extended; 2, contracted; 3, 4, and 5, different forms taken by the head, all life size; 6, bifid form of head, rather larger than life.*

The worm-like creature, with its various forms of head, figured above, scientifically known as a "Ground Planarian," is not noticed on account of any injury which it causes, of which I have no notes, nor do I find mention of it causing, in such publications as I am acquainted with as to its history. But, as among the rare notices of observation of this "exotic worm" in this country, it is mentioned as found in a greenhouse, in hothouses, also amongst broken tiles at the bottom of a pot of Calceolaria which had been in a cold frame all winter, and also amongst broken flower-pots, it seemed to me that a few notes on the subject might be acceptable to some who may be as unacquainted with this repulsive almost poisonous-looking "Flatworm" as I was myself, on as pecimen being sent me for examination in May of the past season.

* The above figures 1–5 are from the plate accompanying the "Note of *Bipalium kewense*, and the generic characters of Land Planarians," by Prof. F. Jeffrey Bell, M.A., Sec. R. M. S., in 'Proceedings' of the Zoological Society of London, 1886, pt. ii. pp. 166–168. Figures 1–5 are copied, excepting in respect of the position of figure 1 being altered to adapt it to space. Figure 6 is from my own specimen, somewhat enlarged.

It was on May 20th (1899) that I received a note from one of our leading horticultural firms asking information regarding the specimen sent accompanying, which had been forwarded to them by a correspondent from an English locality. On examining the moss sent, I saw nothing present excepting a kind of slimy-looking streak, of the nature of which I knew nothing; but, conjecturing from the locality named (a hothouse or some similar locality) that moisture and slight warmth might help to show something more plainly, I placed the moss in some very slightly warmed water, and the effect was rapid.

The slimy streak became evidently alive, and gathered itself together into the shape of what seemed to me something like a Leech, or still more like a small Snake with a bifid head, but much shorter than "1" of the figure at p. 111, and narrower than "2" of the same figure.

The colouring was of a kind of livid grey, with three darker longitudinal stripes starting from behind the head, as especially shown at figures "1" and "6." The head itself was of the bifid shape in front figured at "6"; and during the time that I watched the worm, so to call it, I did not observe any alteration in the form of the head, which alterations were, I believe, first recorded by Prof. Jeffrey Bell as one of the remarkable characteristics of this species. This time of observation, however, was very short, for on feeling the warm water the "Planarian" set out very soon on its journey for more comfortable quarters, and travelled up the sloping sides of the bowl, carrying what I then saw to be its bifid extremity (and subsequently found was its head) steadily before it, and by the help of its flattened under surface it made such solid although slow progress that, as I was at the time quite unaware what might be the habits of the repulsive-looking animal, I thought that the sooner it was shut safely up again the better.

I therefore replaced it with its lump of moss in its box, and returned it to my correspondents, with the suggestion that they should ask the favour of identification from the British Museum authorities at South Kensington.

This they accordingly did, and on May 24th informed me that the specimen had been identified for them as the *Bipalium kewense.* Consequently the animal proved to belong to the *Geoplanidæ*, or "Land Planarians," a division of the *Planariadæ*, which are one of the vast numbers of families into which the great class of *Vermes* is divided. So that for the sake of a generally intelligible appellation, although these "Ground Planarians" differ in important respects from the *Annelidæ*, which include our common Earthworms, they may correctly, as well as conveniently, be described as "worms."

The description of the *Planariadæ* is that the body is of a long oval, flattened shape, often provided with lobed processes, more rarely with tentacles, and, as a rule, with two eyes, which are provided with lenses. The subordinate division of the *Geoplanidæ*, or Land Planarians, is characterised by their *elongated and flattened body, which is provided with a foot-like ventral surface.**

The fullest observations on *B. kewense*, of which I have knowledge, are those by Prof. F. Jeffrey Bell, given in the 'Proceedings' of the Zoological Society, referred to in note, *ante*, p. 111. In this, Prof. Bell particularly directs attention to the variability of the form of the head, so that, whilst the "cheese-cutter," or hammer-shaped head (see figures 1 and 5, p. 111), are very commonly known forms, there may be other shapes, as knob-like, tongue-like, or altogether irregular. Of these and other forms Prof. Bell gives a series of figures (drawn from life under his own superintendence) in the plate accompanying his paper, above referred to, and from these (with acknowledgment of my indebtedness for the assistance) I have given copies in my own figure at heading, p. 111, 1–5. It appears to me of exceeding interest that not only should there be a difference in form of the head under different conditions, but that, as personally observed by Prof. Bell, the head of a single specimen should vary considerably and almost constantly in form, and it is from the changes of one specimen that the figures given are represented.

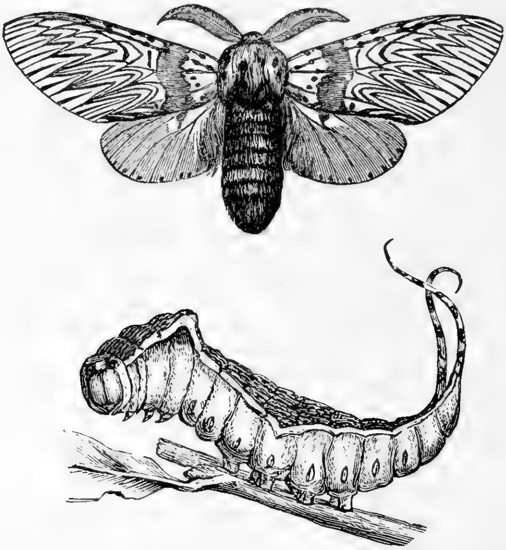
In the case of the bilobed or emarginate head of the specimen under my own observation, I did not notice what the form might be until it was progressing up the side of the bowl, where I had a good view of it against the white china. My figure is given rather larger than life.

Very little information bearing on ordinary points of life-history appears to be accessible. The creature is recorded as having lived in the Kew hothouses for a period which, at the time of writing, extended over eight years; also its great power of secreting slime, so that minute objects causing annoyance could be thrown off "in a continuous sheet of mucus," is noted. I do not find any account, whether in the general habits of the great divisions of *Vermes*, to which the *Planariadæ* belong (or in more special accounts), of these Flatworms being injurious to plant life; possibly this short notice may induce such of my contributors who may be acquainted with them to add some information. But to those who are unacquainted with the repulsive looking creatures, which yet may be come on unexpectedly in earth at the bottom of pots, amongst broken flower-pots, or other horticultural localities, a short notice of the Flatworms, and reference to what, so far as I know, is our fullest British account, may not be unwelcome.

* See 'Elementary Text-book of Zoology,' by Dr. C. Claus, vol. i. pp. 315, &c.; translated by Prof. Adam Sedgwick. 1889.

POPLAR.

Puss Moth. *Dicranura vinula*, Linn.; *Cerura vinula*, Steph. Cat.



DICRANURA VINULA.—Moth (male), and caterpillar (life-size).

The caterpillars of the Puss Moth live on the leaves of Poplar, Willow, and Sallow, and, though not uncommon, do not appear to cause a serious amount of injury, excepting when the attack occurs to trees which are still so young that the loss of the leafage makes an important difference to their growth, or when, as in nursery plantations, they are so very young that the gnawing of the caterpillars at the bark a little above ground-level (in order to furnish themselves with suitable material for their cocoons before turning to chrysalis state) results in such injury to the weak stems that these break off, or the young plant dies from the stem being "ringed."

When full-grown (and extended) the caterpillar is more than two and a half inches in length (without the tail appendages), but its more favourite position is somewhat as figured, with the body resting on the sucker-feet, the fore part raised, and the head drawn back squarely into it, and, in case of the larva being alarmed or irritated, a long crimson silk-like thread is protruded from each of the rough horn-like processes appended to the tail segment.

Notwithstanding its great size, the caterpillar is not very conspicuous, by reason of the greater part of its colouring (excepting in its early life) being of some shade, or shades, of green, much resembling the tint of the leaves on which it feeds. The colours along the back are of a kind of purplish brown, streaked lengthwise with white lines, above the white band (shown in the figure), which it will be seen rises in a point towards the fore part of the body, and runs down in a well-defined angle above the second pair of sucker-feet, sometimes, as shown at p. 114, for only a little way down, and sometimes reaching a considerable way down the side of the caterpillar, with a variety in the accompanying markings, as shown at p. 118. When the head is withdrawn into the following segment it appears as if placed in a squarish pink border, with two black or dark spots, somewhat at the sides.

The life-history is that the eggs are laid singly, or almost singly, near together on the leaves of the trees selected. The earliest date of egg-laying that I find recorded is May 25th, and the eggs* are described as "button-shaped, convex above, nearly flat underneath, fairly round, with a small pit at the apex"; the size from above half a line to nearly a line at the widest diameter, and the height slightly more than half a line; the shell hard, glossy and pitted all over; the colour rich warm brown above, more smoky beneath, the central pit blackish, but ringed with yellowish white. A pale variety of the egg is noted as being chiefly of a buff tint.

The larvæ hatch, as recorded under observation, in a period of from ten to fourteen days, and in their early conditions are so different in appearance from their later development that they are scarcely recognizable as of the same kind. In the past season I was able to make some personal observations on these points, which I give at pp. 116–118, but—continuing the life-history generally—the caterpillars feed until in July, or even in August, they are full grown, and then go down the trees to form their cocoons on the bark not far from the ground. The method commonly followed appears to be to gnaw a piece out of the bark, and in the hollow thus made to spin a tough cocoon, in which the larva turns to the chrysalis state and so remains during the winter, the moths for the most part appearing in the following May.

The caterpillars, however, do not appear to be very particular as to the material of which they make use to strengthen their gluey cocoons; a specimen under my own observation used a small piece of carpet, and thus with the floor of its box made a very solid shelter; another (received last summer) worked up some white cotton wool in which it had been sent, for the purpose; and an instance is given by Mr. Hellins (see Mr. Buckler's 'Larvæ,' quoted previously) of his taking

* For description of eggs, and detailed observations of larval and pupal conditions, see 'Larvæ of British Butterflies and Moths,' by the late Wm. Buckler. Ray Soc., vol. ii. pp. 143–150.

a cocoon from a stone wall near a Poplar tree and finding the cocoon coated all over with little bits of the red coarse sandstone of the wall.

But the instinct of the caterpillars leading them to gnaw their cocoon material from the bark of their food-trees is one of their especial ways of occasionally doing great harm. In the year 1890, an example of this was reported to me in which the little trees were so young and small that the amount of woody material and bark removed by the caterpillar weakened the young Poplar plant to such a degree that the stem broke off. In the specimen sent me, the slender stem was completely bared of bark for some little distance from the hard cocoon, and the young plantation was reported to be *practically destroyed.*

The moths, which may be expected to be on the wing in May, are marked as shown in the figure of the male, p. 114, and are very fine insects; the male about or upwards two inches and a half in spread of its fore wings; those of the female still larger, even as much as three inches and a quarter in expanse. The fore wings are white and grey with darker and black markings; the hind wings white at the base but smoke coloured in the disk; the head white, and the body between the wings whitish with black spots; abdomen whitish grey with transverse darker bands. From their soft furry appearance the name of Puss Moth has been bestowed on them.

The above notes give a general description of the history and habits of the infestation in its various stages, and of the colouring of the caterpillar from the time that it is somewhat more than half grown onwards. But in its early life the colouring is so different that it is not always recognized as being the same species of larva, and on June 26th in the past season a young specimen was sent me from a contributor who had found it feeding on a Willow tree (with enquiries accompanying as to its nature), which gave me the opportunity of watching the change of colour through all but the quite early condition.

When hatched from the egg the caterpillar is described as "a queer little creature," with warts projecting over the head like horns; of an intense sooty black above and black with claret tinge below.

My specimen had advanced beyond the quite earliest condition, but the upper part (which in mature state is of a purplish colour, streaked longitudinally with white lines) was still jet black, and the lower part of the body of a clear yellow. Behind the head on the next segment were a pair of lumpy black processes of a somewhat horn-like shape, placed on each side. These, when seen with a moderate magnifying power, appeared to have several reddish spots at the extremity. The larva fed fairly well on Poplar, and on June 29th had grown to approximately a length of half an inch. The colouring was now of brown tint with minute mottling of darker brown above, and green below; the black tubercles behind the head were covered with sharp spiny processes, and (together with these) were of a somewhat spherical shape, widening below into the first segment behind the head, of which they formed part. The caudal horns were spiny, of a somewhat yellowish and varied brown at the lower part, and nearer the extremity with two dark brown bands separated by a pale one; the tips were of a purplish pink.

The caterpillar fed heartily on fresh Poplar leaves, and continued growing; on the 30th a streak of darkish colour was noticeable running down the side from the lowest angle of the dark colour on the back, and by July 2nd the tubercles behind the head appeared of a more triangular shape, beset with upright prickles, but altogether lessening rather than increasing in size compared with that of the grub.

In the afternoon of the same day about 1.45 p.m. I noticed that the caterpillar had moulted, the tails showing distinctly in the cast-off skin. The processes behind the head now appeared as little more than prolongations of the raised band between them, with some rather blunt prickles at the tip and to some degree around them. The moulted off skin of the eyes and mouth were lying apart from the rest.

July 10th. About two days previously to this date the caterpillar began to spin a slight amount of web on the leaf surface, and exuded a large drop of transparent green fluid; the larva remained stationary at one spot, and apparently was firmly fixed by the sucker-feet in its web, for I was unable to detach it. On the morning of the 10th about 8 a.m. I found the caterpillar had again moulted its skin, including the candal tails and the prickly tubercles from behind the head.* The colour had become lighter above, and the central raised point above the third segment was now partly of a dull pinkish colour. The localities where the spiny tubercles (now moulted off) had been were smooth, and there was now a pinkish line of about the length of half the space between them just above the head. About 10 a.m. the larva had turned round, and appeared to be devouring the shed skin. The tails or caudal appendages were now, excepting towards the base, white, with rings, prickles, or slight knobs of black.

July 11th. The caterpillar was feeding heartily again, and growing fast, and had now a pink line all round the face, with pale yellowish or whitish border outside (at the sides), and treacle-coloured or pitchy spot on each side above the face, taking the place of the spiny tubercles.

July 14th. The caterpillar was feeding greedily, and was now grown to what was presumably its full size, being somewhat more

* In the account by Mr. Hellins, in 'Buckler's Larvæ of British Butterflies and Moths,' referred to, p. 115, of his observations of the changes of the larva of the Puss Moth, he mentions that he has not details of the fourth moult, but that at the fifth "the horns are gone and their places marked by dark velvet spots!"

than two and a quarter inches in length from head to base of the horn-like tail processes. The colours had developed well, and, without entering too tediously on details, might be said to show the customary characteristics. The back was mostly of a purplish brown, darker at the edges, and varied with minute white dots and longitudinal streaks. The segment behind the head for the most part greenish in a transverse band in the fore part (excepting the pinky colour above the face, and dark patches at corners above the face), and the centre of the next segments palish with somewhat greenish tint. The face itself brownish.

My specimen proved to be one of the varieties possessing a dark patch on the side, placed just below the lengthened angle of the dark

Larva of Puss Moth before last moult; also full grown, showing side mark.*

dorsal stripe, and known together with it as the stirrup and saddle flap. Mr. Hellins records "six good variations" in form of the flap and stirrup, and that on my specimen must have been one of the most marked mentioned, and there was also a dark spot on the side of the next segment just above the sucker-foot. The abdomen was green, deepest in tint at the lowest part of the sides, with two long dark stripes running beneath from the fourth sucker-foot to the tail.

The above details do not perhaps bear much on practical economic considerations, still they may be of service in drawing attention to the infestation before it gains its full-grown voracious conditions, and even as matter of curiosity the main points of the changes appeared worth record when I had the rare opportunity of observing them.

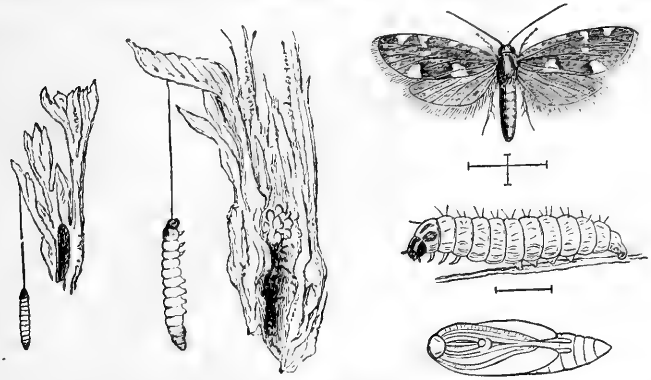
Prevention and Remedy.—Excepting where the attack occurs to very young trees or in nurseries, where, as noted at p. 116, the plants are so small that they quite fail under attack, there seems to be little need of taking measures against this infestation.

* The above figure is mainly copied from that given at Plate xxxii. fig. 4, c, of 'Larvæ of British Butterflies and Moths,' but with comparison with my own specimen. The smaller figure is copied from 4, b, of the same plate, and indicates the appearance of the tubercles behind the head seen from above.

The caterpillars are of such a great size for some time before they have attained their full growth that, when the operator's eye has become accustomed to distinguish between their green tints and that of the leafage, they may be very easily hand-picked off trees still small enough to lie much under their powers of doing mischief. Attention would be drawn to some creature requiring removal being present, by the gnawed state of the leafage, and whether in the black and yellow or purplish and green condition it should be cleared.

RASPBERRY.

Raspberry Stem-bud Caterpillar. *Lampronia rubiella*, Bjerk.



Lampronia rubiella.—Moth, magnified, and with lines showing natural size; caterpillars, natural size, and somewhat magnified from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood.

The attacks of the little red caterpillars of the small moth (figured above) scientifically known as the *Lampronia rubiella* sometimes cause serious damage by their workings within the buds and young shoots on the Raspberry canes early in the season. The mischief is begun in spring by the young caterpillars (which have lived in caterpillar state throughout the winter) making their way into the young leaf-buds, and, as the season advances, the injury that is going forward becomes very noticeable by the fading of the young shoots which have grown from attacked buds, or are themselves undergoing attack.

The infestation is not of yearly recurrence to an important extent, but it is one of long standing, certainly since as far back as 1853. It has only twice been reported to myself as serious, namely, in 1883, and again in 1891, in which latter year it was present at a good many English localities, and also near Glasgow and near Crieff in Scotland.

In the past season I had some slight mention of the infestation being present at Loughborough and at Rugby in England, but notes were also sent me from Carluke, Co. Lanark, N.B., of the Raspberry growers in that district being so greatly troubled by the appearance of the caterpillar in their plantations, and the damage being caused by it to the buds on the canes, that some further observations on the life-history of the infestation appear to be needed.

The commencement of the life-history of this infestation *does not take place* when the mischief from it (as above) is first noticed, but in the *preceding summer*. The moths lay their eggs in the "receptacle" of the open Raspberry flower, the eggs being deposited about their own width below the surface of the receptacle.* There the maggots or caterpillars hatch, and feed in the gradually forming white fleshy "receptacle" until the Raspberry is ripe, when they are full-fed, and leave their feeding ground. This may either happen by their simply going away, or by boring an exit-hole out at the base by the footstalk. They then go down to the stool of the plant, and spin a little round flat white silk cocoon, not much more than the twelfth of an inch in diameter, in which they pass the winter.

This is the first part of the life-history, which is seldom noticed, because the presence of the little caterpillars in the white "receptacle" does not appear to interfere with the development or with the ripening of the fruit, and the above points—that is, the locality where the moth (which is known to be common in June) *lays her eggs*, and where the young caterpillars feed until they shelter for the winter—were, I believe, unknown (or only vaguely and in very small part noted) until observed and recorded in 1891 by Dr. T. A. Chapman, of Hereford.†

With the following spring *the second part of the attack begins;* the little caterpillars come out from their cocoons, and mount the canes, and proceed to attack the buds and do mischief, but with some variety in the method of their operations. When the attack is in progress, the maggots (larvæ) may be found crawling on the canes, and some emerging from the buds (to renew attack at pleasure), also some of the buds may be found burrowed from base to top, and some with a maggot still within them. As the attack, or rather as the season, advances *young shoots* will be found failing from the presence of the pest within, so that I have had notes of shoots failing up to the extent of ten to

* The "receptacle" may be generally described as the central part of the Raspberry flower, which in due time enlarges into a white somewhat cone-shaped mass occupying the centre of the Raspberry fruit.

† See "The Oviposition and Autumnal Larva of *Lampronia rubiella*," by Dr. T. A. Chapman, in 'The Entomologist's Magazine' for June, 1891, p. 169.

fifteen acres of plants being so damaged that they appeared as if frost-bitten, and also of shoots infested by the larva of this *Lampronia rubiella* being gathered by basketfuls. This collection was made on May 12th.

At May 18th I have had specimens sent me of the caterpillars then beginning to spin up and change to the chrysalis state. So far as *I have seen*, this change takes place in a bud, but it may very possibly occur in the cane if the maggot has bored from the bud into it, or in the young shoot—in fact, wherever the caterpillar may have been carrying on its destructive work.

The Raspberry Stem-bud Moth caterpillars are about a quarter of an inch long, of some shade of red, with black head, and black mark on the following segment; they have three pairs of claw-feet, which are black, and also four pairs of sucker-feet, and a pair at the end of the tail. When examined through a magnifying glass it will be seen that there is a pale line down the centre of the black head, and that the mark on the following segment is composed of a pair of double-spots.

Of the caterpillars sent me on May 18th, noted above, one had spun up, excepting at the head end, the colour beneath having become yellower. A chrysalis (spun up in web in the bud) was tawny or reddish yellow on as much of the back from the head onwards as was visible. The wings, which were folded beneath it, were yellowish. The abdomen was of a full pink.

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

The following are the main characteristics of the appearance of the moth; see also figure at p. 119:—The expanse of the wings is a little under half an inch. The head ochrey grey with yellowish face; horns dull brown. The fore wings shiny, with a brown ground, marked with yellow dots and various yellow spots; of these spots two are very noticeable on the hinder or inner margin, and there are four smaller spots on the costa or fore edge. The fringes are brown, with tips white at the end of the wing. The hinder wings brown, with paler fringes.

From the notes of life-history given above, it will be seen that this is what may be well described as an attack in *two parts. The first is the summer to autumn part*, from the opening of the Raspberry flower to the ripening of the fruit, in which no observable damage is done, but still the foundation of the future mischief is laid. Winter is a time of quiescence of the infestation in its little cocoons. *The second part is the spring to summer attack*, of which the damage is well known.

This begins with the swelling of the Raspberry buds, or even earlier, and continues till the caterpillars spin up; the moths from the chrysalids coming out at the season of the opening of the Raspberry flowers.

This life-history, as we know it now, and for which in its early part we are mainly indebted to Dr. Chapman, gives us the key for practical operations on the pest, for want of knowledge of which, as will be seen by some of the following observations, both loss of crop and disappointment from unsuccessful attempts at remedial measures, were incurred even in the past season.

In the past season the report of attack at Loughborough merely referred to the specimens sent accompanying, and which proved to be of the *Lampronia rubiella*, as a kind of infestation with which the sender was previously unacquainted, and which was injurious to Raspberry canes by boring into the young shoots, and thus slowly killing them. The date of communication was May 12th.

In the following observations, sent me rather later in the month than the above, on May 23rd, by Mr. W. T. Fisher, from Clifton Road, Rugby, it will be seen that he especially draws attention to having found many of the scarlet caterpillars of *L. rubiella*, not only on the Raspberry canes themselves, but also on the "young shoots coming up from the ground." I do not remember that this circumstance has ever been recorded previously, and if on investigation it should prove to be a common habit of the caterpillar to work in the young shoots from the ground, as well as in the young shoots from the canes, it would be a point well worth attention. Mr. Fisher remarked as follows:—

"*Lampronia rubiella.*—I have found a great quantity of these scarlet pests on my Raspberry canes this spring. Every withered shoot has been most religiously removed and burnt at once, but on looking over them myself, I noticed that it is not sufficient to look over *the canes* themselves merely, but the young shoots coming up from the ground also require the keenest scrutiny if the greatest benefit possible is desired from the labour expended. I estimate that from ten to eighteen per cent. of the total destroyed came from this source, so that, if these had been neglected, a relatively large number would have been left to propagate the mischief next year."—(W. T. F.)

On April 26th information was requested from me by Mr. Robert Scott, of the firm of Messrs. R. and W. Scott, of the Clydesdale Preserve Works, Carluke, Co. Lanark, regarding presence of the same infestation (namely, *Lampronia rubiella*, of which specimens were sent) to a serious extent in the Raspberry plantations in the district; and amongst other points it will be seen that available information was still so much needed that what may be called double loss was being occasioned; this being partly from the attack not being checked, and partly also by the attempted remedies causing injury to the plants. Several points of interest were mentioned, and amongst them the circumstance that the Raspberry canes throw out secondary shoots from the base of the injured buds, and thus a moderate crop was secured from the infested canes, although somewhat late in date. The first of Mr. R. Scott's communications, sent me on April 26th, was as follows:—

"The Raspberry growers around this district are being seriously perturbed over the appearance in their plantations of a small red caterpillar, which exhibits a marked liking for the buds of the Raspberry canes. I am sending per parcel post a number of short lengths of canes, which show manner of attack. The writer is of the opinion it is the Raspberry Moth caterpillar, as detailed in one of your Reports some years ago, but as said Report has gone amissing, reference cannot be obtained. The chief matter in doubt at present amongst growers is the condition and situation in which the caterpillar hibernates. It is presumed that it is in the ground, but the caterpillar being so small and the numbers on the canes so great, many are disposed to doubt this. If the Report has impressed me correctly, the caterpillars hatch out in the summer, and, passing into the ground, hibernate there until they appear, still in the caterpillar form,* in the following spring. To meet this condition of things, a number of growers tried gas-lime around the stools, but with disastrous results to the following crop, as a very large percentage of bearing canes never started a bud, and those that did start were much feebler and later than usual. It is probable, however, that the quantity of gas-lime, eight to twelve tons per acre, was too large a dressing. Spraying has been adopted, Paris-green and quassia chip solution, but, so far, I rather think the result is not up to expectations. For one thing, spraying was too late in being done, caterpillars being safely hidden inside the buds. The only redeeming feature is that, while the first buds may be irretrievably ruined, the Raspberry canes throw out secondary buds from the base of old buds, and these give a moderate crop, although later than the original buds would have yielded.

"The form in which canes are tied in this district is no doubt rather in favour of attack. Either the canes of each stool are taken and tied somewhat firmly (practically in a bunch), or else half of the canes from each of the stools are brought together in the form of an arch, and tied in that position. Under such conditions caterpillars

* It will be seen that the above observations are very nearly although not quite correct. The caterpillars *do go down* from the Raspberry fruit when full-fed, but the spinning up for hibernation has not been recorded as taking place anywhere excepting on the stool.

have free access from one cane to another, no isolation of individual canes being possible, as would be the case where canes are spread out fan-shape on wires."

On May 14th Mr. R. Scott communicated further regarding the date of the first observation of presence:—

"This moth, until about six years ago, was unknown in the district around here; but about that time one or two growers purchased Raspberry canes (rooted) for planting purposes from England, and it would appear that the infestation was introduced from that quarter, the more so as the grower most badly attacked at the beginning was one of the purchasers referred to."—(R. S.)

On July 6th Mr. Scott noted as follows:—

"The Raspberry Moth, about which I wrote you previously, has been pretty generally destructive all over the district, but from my own experience and the experience of others, I should say that the damage is not nearly so great as was once feared. The secondary buds that started from the base of the buds destroyed have come away nicely since the rain fell, and, though the fruit will be a little later, it is not likely to show the sad shortage of crop that so many had anticipated."—(R. S.)

Prevention and Remedies.—One of the most effectual methods of checking *recurrence* of attack must certainly be that mentioned above, of breaking off the infested buds, or little shoots, and destroying them. On an occasion of a visit of the Evesham Fruit Experimental Committee to the Toddington Fruit Grounds on May 12th, a large basket was shown filled with Raspberry shoots infested by caterpillars of *L. rubiella*, as a sample of several other basketfuls which had been collected in the previous part of the day, and sweeping clearances of this kind cannot fail to make much difference in the amount of recurrence of the infestation.

This method of clearing the pest, however (as previously mentioned in my 'Handbook of Orchard and Bush Fruit Insects,' p. 210), requires some care in carrying out, for, as has been shown, the caterpillar by no means necessarily remains in its own bud. To prevent escape, the buds, or embryo shoots, might be cut into pails with a mixture of soft-soap or of any sticky fluid in them which would prevent the caterpillar crawling away, or a rough lining of canvas to the collecting baskets which would allow of a good sprinkling of paraffin oil (or of anything that the grubs would not cross at the edges), would probably be a good plan.

In any case the broken-off buds and shoots should be burnt or destroyed in some way as soon as possible, or otherwise, in case the caterpillars are so nearly full-grown as for the time of their change to chrysalis state to be at hand, almost as plentiful a development of the moth may be expected from the gathered shoots as if they had remained on the bushes.

Excepting in the case of the experiment noted at p. 123, no deterrent measures appear to have been tried with regard to the establishment of little red caterpillars when they *come down* to the old stools from the ripe Raspberry fruit to spin their little cocoons on them for hibernation; nor when they *come out* from these cocoons on the stools (or it may be also from other sheltering-places where they have passed the winter) for their attack on the buds of the canes. But when there was reason to expect bad attack, it might for one thing be worth while to try the effect of some preventive dressing thrown round the bases of the canes; and also a much more complete removal of old stumps and rubbish and everything that would shelter the infestation in its winter state than is commonly carried out, would certainly be very helpful in getting rid of a deal of coming infestation.

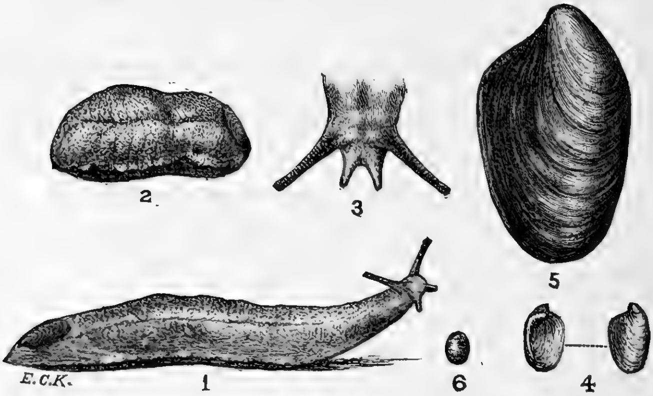
In regard to preventive applications when the caterpillars are coming down to spin (that is, presuming that the method of growth allowed the stools to be got at without unreasonable trouble), it might be worth while to syringe a solution of soft-soap and water amongst the stumps of the old stools and rubbish. Or it might help a good deal to throw a dressing at the bottom of each plant of some dry material mixed with paraffin at the rate of a quart of the mineral oil to a bushel of ashes, dry earth, or whatever might be thought best to use. We know from broadscale trial that the paraffin in the above proportion did no harm to the tender shoots of Hops coming up through it, and therefore there does not appear reason to fear that it would be injurious to the Raspberry stems in any stage, and it might have a very good effect in preventing establishment of the caterpillars when they come down, and very likely, if established, lessen the numbers going up again in spring.

For ground dressing, where it is thought desirable to try this (as some cocoons may be spun on rubbish on the surface), some kind of application would be best that is known by common practice to be harmless to plant health if used in ordinary amount, also that acts as a stimulant to growth, and also which it *may be hoped* will act as a deterrent on progress towards development of the young caterpillars. Nitrate of soda, sprinkled in an amount representing an ordinary top-dressing for field use on the surface beneath which maggots of the Pear-tree Midge had gone down to change, was found to act so that not more than ten per cent. were alive, so far as examined subsequently, in their cocoons. Kainite, applied from "sprinkling with a small quantity" experimentally up to a "heavy top-dressing," or at the rate of over half a ton per acre on orchard land, had still better effects. The maggots, in the instances examined, were found *dead* "in their cocoons." The cocoon in which the Pear Midge Maggot passes the winter (for it does not change to chrysalis in it until early spring) is spun of silk, covered with grains of sand, and, as the rather slighter silk cocoons of the Raspberry caterpillars appear to offer no better defence from action of surrounding chemicals, a trial of effect of an autumn dressing might be well worth while. Notes on the successful effect of kainite as a preventive dressing for Pear Midge infestation will be found preceding, under this heading.

SNAIL-SLUG.

(BENEFICIAL.)

Snail-slug. *Testacella haliotidea*, Draparnaud.



TESTACELLA HALIOTIDEA.—1, Snail-slug, in motion; 2, contracted; 3, head, with tentacles, magnified; 4, shell, upper and under side, slightly magnified; 5, shell, much magnified; 6, egg. (4 and 6 from plate v. of Jeffrey's 'British Conchology,' vol. i.; the other figures from specimens taken at St. Albans.)

The Snail-slug greatly resembles several kinds of our common garden and field Slugs, but is distinguishable from them by having a small external shell placed near the end of the tail. From this circumstance of possession of a noticeable shell (although certainly it is a very little one) the creature takes its popular name of the Snail-slug; but, so far as my own experience goes, the point which most frequently attracts attention to these Snail-slugs not being of the common plant-eating kinds is their being found in the act of swallowing, or in some way or other to be, or very recently having been, feeding on an Earthworm.

The *Testacellæ* differ so entirely in nature of food from our common Slugs, that they are beneficial to us by ridding us of small ground vermin; they are wholly *carnivorous*, and prey chiefly on Earthworms, but also on Slugs and Snails, and even on each other.

During the day they live mostly underground, and are to be found in gardens, and at the foot of old walls, by roots of plants, &c. How far they may come to the surface at night to feed does not seem clear; they are recorded as sometimes coming to the surface in breeding time; also it is said that the *Testacella* only sallies out at night in search of prey; also it is said that those who wish to procure specimens should look for them at daybreak, especially after a warm dewy night in the months of July and August. But whatever variations may occur as to coming to the surface by night, there appears no doubt that as a regular thing they live underground by day. *Through* the ground beneath the surface they hunt the Worms on which they principally feed, their great compressibility of body, and also their power of lengthening or contracting themselves at will, giving them great facilities of movement, and after having gorged themselves they can remain for a fortnight or more without food.

Heavy rains destroy great numbers of them, but cold is stated not to do them harm, and as a protection when cold winds are prevalent, they are recorded as enclosing themselves in a kind of case formed of slime secreted by the skin, and often mixed with extraneous particles. In winter they bury themselves very deep in the ground.

The average length of life is considered to be five or six years, and they multiply by eggs which are laid separately, and are very large in proportion to the body.

The *Testacella haliotidea* (figured from life at p. 126) is, when full-grown, as much as three inches in length, and four-tenths of an inch in width. The body firm in texture, cylindrical, and very flexible, contracted towards the front, and somewhat broader behind the middle, capable of extending itself like a worm, and the skin smooth when the animal is crawling at full length, transversely wrinkled when at rest. The back convex, divided longitudinally into three nearly equal parts by two grooves, which run along each side from the front edge of the shell to within a short distance of the tentacles, or horns. These longitudinal grooves have (*typically*) transverse lines running downwards from them; but in my specimen, though the long grooves were plainly observable, the offsets of lesser lines were not noticeable; this very probably from the Slug having been for some days not in natural circumstances.

The colour is very variable, but is generally described as yellowish brown, mottled with black, red, or white. Tentacles (horns) four; eyes placed not quite at the tips of the upper pair; and beneath the much shorter *lower* pair of tentacles are a pair of processes much shorter and thicker, which are technically the "lips," or "labial palpi," and are flexible and extensible. These are not given (consequently on position) in my figures.

The shell (see figures 4 and 5, p. 126) is about a quarter of an inch in length, somewhat more than a sixth in breadth, oblong in shape, compressed, rounded at the front margin, obliquely truncate at the hinder margin, and the spire terminal and very small.

In the variety *scutulum* of Sowerby, the shell is narrower, and the spire more produced and pointed. The *above* description, and some parts of the preceding life-history, are mainly taken from the information given by Prof. J. G. Jeffreys in his work referred to below *; but, for the sake of convenience of reference, I have given some of the peculiar points as to appearance and habits recorded generally as customarily characteristic *in connection* with the notes given me of observations in English gardens (see following pages), as thus we have the general digest of information confirmed by notes from given localities.

A further point which bears strongly on the great power of the *Testacella* in pursuing its prey through the ground or passages left by worms is its extraordinary compressibility. In my own observations I have seen a well-grown specimen in the operation of escaping from under a bell-glass, where it was confined, squeeze itself so forcibly between the edge of the glass and the surface beneath (where apparently passage was impossible) that, as the fore part of the body passed, it became as completely flattened, or more so, as the empty finger of a glove when the two sides are compressed together.

The largest number of *T. haliotidea* which I have myself found in one locality was in the kitchen garden at Dunster Lodge, Spring Grove, near Isleworth, whilst resident there before removing to St. Albans. Here we found so many on one occasion that we sent twenty or more to a scientific friend, these being all collected at one time. From the length of time since I left the above neighbourhood, I cannot give the exact numbers we found with certainty, but it was, as far as I remember, as many as forty or fifty, and they were of various ages.

Amongst more recent observations, it was on April 30th, in 1897, that I received from my friend and near neighbour, Miss Nisbet, of The Abbey Gate House, St. Albans, two specimens, which, on

* 'British Conchology,' by John Gwyn Jeffreys, F.R.S., &c., vol. i. pp. 140–148, plate v. figs. 6, 7, and 8.

examination, proved to be of *T. haliotidea*, with the observation that they had been found that morning by the gardener at the root of a Rose. This Rose tree was not in the open ground, but nailed against a wall, and the Snail-slugs were found *under the roots*.

On receipt of the specimens I laid them on some damp earth, sprinkling a little earth over them, so as to place them in fairly natural circumstances, and supplied them with a few live Earthworms. On examination on the following morning (May 1st), I found one of the Snail-slugs on the surface of the soil, so firmly attached to one of the Earthworms, which it had torn open, that I repeatedly lifted up the Slug by raising the Earthworm. It was somewhat contracted in shape, but, after letting go its hold of its prey, it drew itself up so as to be only about an inch in length, and consequently thickened to about half an inch in breadth, and three-eighths of an inch in height at the middle, thus assuming a somewhat arched figure,* highest in the middle, and lowest at the ends when seen sideways. The under surface, technically known as the foot, was flat.

The other Snail-slug was contracted as if dead, but presently extended itself again, and protruded its tentacles, commonly known as its horns.

These two specimens of *T. haliotidea*, Draparnaud, resembled the variety *scutulum*, Sowerby, in colouring, the body being of a *yellow* colour speckled with dark brown, rather than of "yellowish brown," variously speckled or mottled. The body below was of a rich yellow orange. The shell, however, did not appear to be *certainly* narrower than that of *haliotidea*. As there is great variety both in the colouring and form of the shell of the Snail-slug, it was difficult to say certainly whether the specimens were of *T. haliotidea* or var. *scutulum*, but, as this variety is mentioned by Mr. Sowerby as occurring in many parts of the Metropolitan district, it may be of interest just to allude to the different colouring.

The specimens, when ordinarily extended, were about two inches in length (see fig. 1, p. 126).

The persistence of attack of the Snail-slug on the Worm agreed with the account given by Prof. Jeffreys in his detailed observations (referred to at p. 128, preceding) of the habits of the *Testacellæ* as Worm-hunters. Here he mentions, amongst much interesting detail, the Snail-slugs hunt underground, and seize a Worm by the middle, and when the writhings have been succeeded by exhaustion they detach and swallow a part of the Worm, and when it has been digested finish their meal with the other portion. "For this purpose its mouth is furnished with an apparatus of sharp recurved teeth,

* See figure 2, p. 126.

which enables the *Testacella* to retain a firm hold of its victim, and swallow it more easily."

On Sept. 21st, 1897, I received a short note from a correspondent (living at Aylesbury, Bucks) mentioning, in the course of other communication:—

"I may say that we dug up in the spring an unusual number of Slugs, owing, I presume, to the mildness of the late winter and absence of frost. We found two or three specimens of a hard Slug with a small Worm half down his throat. I was not aware they lived on these things."—(J. W.)

Here we have another illustration of the habits of the Snail-slugs of living underground and preying on Worms. In this instance, as I did not see specimens, I cannot tell which of the two species of *Testacella* that are found in Britain might be referred to. Only two distinct species are recorded, namely, *T. haliotidea*, which is by far the best known, and *T. maugei* of Ferussac, which is noted as being found established during a long course of years at the gardens of a nursery firm at Bristol, and likewise at a garden at Swansea occasionally supplied from the above gardens, likewise at a few other places. This species has a smaller head, as well as "*a much larger and more convex* (*almost semi-cylindrical*) *shell than haliotidea*."—(J. G. J.)

On April 25th in the past year (1899), I was kindly favoured by Miss F. Curtis with the following observation on presence of Snail-slugs in the gardens at Potterill, Hatfield, Herts, which it will be seen embodies in a few words three noticeable points regarding their habits—namely, that they are constantly present in the earth, but *hide in the daytime;* likewise that they have been observed *in the act* of swallowing Worms. In Miss Curtis's own words:—"The gardeners constantly find them in the earth, and have seen them swallow Worms, but they generally hide in the daytime."

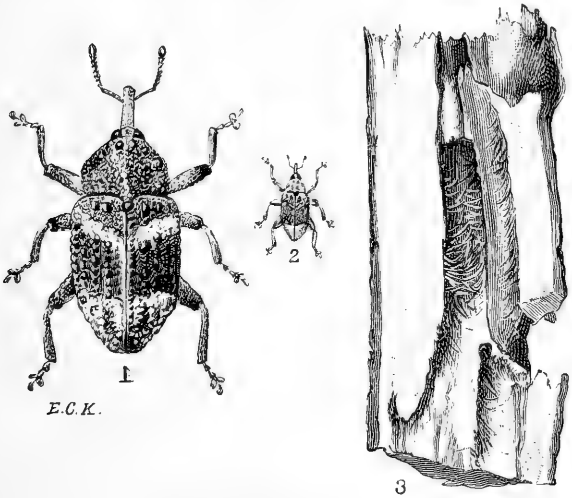
In reply to my enquiries whether Miss Curtis could be good enough to furnish me with any more information on the subject, she mentioned that the gardener, who was the special observer of the *Testacellæ*, said:—

"They never saw any in this garden till about ten years ago, and then they were found near an old Quince tree. Now they have seen as many as ten together in a small piece of ground, and though they scarcely ever find them, except when they are turning over the ground (about three or four inches below the surface), the one sent me was picked up off the top of the soil. The gardener thinks they lie dormant in winter time, and he has noticed little dents in the soil where they have lain. When they cut one of them in half, they found a long Worm inside!"—(F. C.)

Those who wish to follow up details in a fairly accessible publication, will find much of interest in Prof. Gwyn Jeffreys' 'Conchology,' referred to at p. 128, where also a large number of references are given—names of writers, or observers, of the *Testacellæ*, from 1740 onwards. But I am not aware of what may be called practical notes of observations of the creatures *in situ* in our own gardens having been given attainably for reference, and the very useful though unprepossessing creatures appear to be usually so wholly unknown to their garden observers, that the above notes may be of service in pointing out that, though unpleasant in appearance and disgusting in the details of their Worm-feeding habits, they are really very useful.

WILLOW.

The **Mottled Willow Weevil.** *Cryptorhynchus lapathi*, L.
"**Alder-killer**" (German).



CRYPTORHYNCHUS LAPATHI.—Beetle, natural size and magnified; Willow stem tunnelled by larvæ.

The very pretty little beetle figured above is not often reported as causing much harm, but it is widely distributed in England, and to some degree in the more southerly parts of Scotland, and was known as injurious to Willows at least so far back in date as about 1840.

The Willow is the tree which is recorded as most liable to its attacks. In 1838* it is mentioned as exceedingly abundant in the

* See Loudon's 'Arboretum et Fruticetum,' vol. iii. p. 14.

Osier beds near Barnes and Mortlake; and in Selby's 'Forest Trees' (published 1842), at p. 165, it is mentioned by the writer that he had personally observed young trees of Willow attacked, and the wood "*riddled*," as it were, by the grub of *C. lapathi*. Alders are also subject to attack; and in German observation Poplars and Birch are also mentioned as liable to infestation. So also is a species of Dock (*Rumex*),* from which circumstance the specific appellation of *lapathi* has been given; but the correctness of the observation of the weevil being *feeding* on the Dock (and not merely chancing to be on the plants when growing under Willows) has been doubted.

At the end of October, in the past season, Mr. Alex. G. Higgins, writing from Bexhill-on-Sea, Sussex, favoured me with the following notes regarding attack to Willow, with specimens accompanying of the injury caused by infestation to some small Willow stems, from a part of one of which the figure (p. 131), showing the destructive extent to which it had been tunnelled, is taken. Mr. Higgins remarked as follows:—

"I am sending you with this a box containing a couple of sections of good-sized shoots of Willow (the long narrow-leaved variety), and you will perceive them, one in particular, to be tunnelled, principally in the axis of the shoot, with short stout tunnels, which, in the recent state, were filled with frass. What I believe to be exit-holes may be seen on the outside bark.

"In some of the tunnels, at one or other end, and dammed up by the frass, I found, in some cases, the larva, more commonly the yellow soft-bodied pupa, and much more frequently the perfect 'imago,' one of which I enclose.

"As to any evidence of destructiveness, . . . I can only say that on the small shrub-like Willow plant I took the accompanying specimens from, there were no very marked signs of internal insect ravages, except the frass-plugged holes through the bark; that is to say, but few branches had died, and the foliage had apparently not suffered. All the same, . . . I should judge the tree will be ultimately killed, perhaps in two or three years' time.

"In the smaller of the two shoots, the single cavity there was

* *Lapathum* of Tournefort is the scientific name of one of the two sections of the genus *Rumex*, Linn., of the great order *Polygonaceæ*. Most of the species of *Rumex* are known popularly as "Docks," with some prefix, as "Curled Dock," "Sharp Dock," &c., and as some are especially to be found in watery places, it seems likely enough that *Cryptorhynchus lapathi*, which frequents Willows and Alders, should be found sometimes on these moisture-loving plants also. But as it is not obvious at a glance what connection there may be between the specific name of *C. lapathi* and a "Dock," the above note may be of some interest.

For botanical reference, see Sowerby's 'English Botany, vol. viii. p. 40; also Babington's 'Manual of British Botany,' p. 271.

occupied by a dead and disintegrating 'larva,' and presumably the egg was laid in or about the bud, towards which the short cavity is directed."

On Nov. 1st, Mr. Alex. Higgins noted further:—

"Since writing, I have got a number more of infested shoots all of which are from Willow, and the selection of *Willow* is the more marked, as in the immediate neighbourhood there is abundance of both Poplar and Sallow.

"I noticed, in handling some rather lively specimens of the beetle this evening, that they very frequently, when touched or otherwise annoyed (?), give rise to faint but definite squeaks not at all unlike the sounds produced when an indiarubber doll is squeezed (in quality only, of course). This, of course, is but an example of many similar in the insect world—as, for instance, in '*atropos*.'"

In the above notes the mention of the especial selection of Willow for attack, although in proximity with Poplar and Sallow, is of interest; and so also is the observation of the beetles giving rise to a squeak-like noise on disturbance.

Of this peculiar sound, it is noted by Prof. Westwood *:—"According to Lister, this insect emits a querulous sound when alarmed (De Scar. Brit. App. Hist. Ins. Raii). This noise is produced by rubbing the base of the prothorax against the narrowed front part of the mesothorax."

In vol. iii. of Loudon's 'Arboretum et Fruticetum,' at p. 1480, is given what I presume to be the same information, though rather differently worded, from the Ashmolean Appendix to Ray's 'Historia Insectorum.' Here it is recorded that "it possesses, though feebly, the faculty of voice"; and the statement, "Lacessitus, vocem quærulem dedit" (that "on being disturbed or provoked, it makes a querulous noise"), agrees with the observation that I was favoured with from Bexhill (see above). It would be of a good deal of interest to have some more observations as to this noise, and the method of its production, for in all the modern accounts of the beetle's habits which I have opportunity of consulting, I have not found any allusion to this power of emitting sound.

The beetle is about the third of an inch in length, rough, the ground colour black, but with the sides of the thorax, a more or less irregular transverse band near the base of the wing-cases, and about a third of their length from the tip, of a yellowish colour. The thorax with the sides rounded, and coarsely punctured, the front portion bearing little bunches of bright black scales. The wing-cases with the band at base varied with black or fuscous, and punctate; the

* 'Introduction to Classification of Insects,' by J. O. Westwood vol. i. p. 344.

punctures of the striæ *very large;* the interstices closely punctured; the third, fifth, and seventh furnished, like the thorax, with bunches of bright black scales. Head black; proboscis stout, and slightly curved, and, when at rest, fitted beneath the thorax; horns reddish, elbowed, and terminated by an ovate club. Legs black; in the specimens before me more or less marked or banded with ochreous, especially on the thighs of the fore legs. Wings transparent, with strong veins, those at the lower part chestnut coloured.

The above notes give a fair description of the appearance of the beetle as seen natural size or slightly magnified; but (when under a powerful magnifier) the marking will be seen to be elaborately and delicately varied. The black thorax has three longitudinal lines of yellowish colour more or less present; and the wing-cases have variations of black dots on the yellow-tinted apical portion; and other distributions of whitish or yellowish tints, together with the large shallow punctures of the striæ, on the wing-cases, and the bright black bunches of scales, give a variety to the appearance almost impossible to describe.

The larva, or grub, is stated to be very like that of the Pine Weevil (*Hylobius abietis*). It is about half an inch long, body whitish, sprinkled with bristly hairs standing well apart, with two longer bristles at the hinder angles of the tail extremity. The three rings behind the head are swelled beneath, with a semicircular enlargement on each side bearing a bristly hair.

The beetles are to be found pairing on shoots (as of Sallow or Willow) at the end of April and beginning of May, and it is observed that, whether singly or in pairs, they will fall to the ground on the slightest shake, and lie there for a long time as if dead. During the period of its existence in beetle state the infestation does some amount of harm, but the mischief from this cause is not by any means necessarily serious, as the duration of life-time is limited.

The life-history, put shortly, is that the females lay their eggs singly on the stems of their food-plants; in about fourteen days the larvæ hatch, and, after gnawing under the bark, bore tunnels in the wood, leaving the rubbish or dirt from their gnawings pressed together behind them. As the larva increases in size, the brown "boring chips" and excrement are thrown out at the aperture of the boring. So far as is shown by published descriptions and figures, and comparison with such specimens as I possess, the tunnelling in the wood of the small stems has no marked characteristic; the galleries may run parallel along the inner part of the stem (as shown in the figure, from life, at p. 131, of a Willow stem an inch in diameter), or they may take a slightly winding course.

In the figure now before me (in 'Forest Protection,' by Prof.

W. R. Fisher, p. 199) of larval burrows of *C. lapathi* causing injury to an Alder stem, about three-quarters of an inch across, they may go in a more or less slanting direction from one side of the stem to the other. In these galleries the frass, or "bore-chips," is very noticeable, and so is the condition of the *outside* of the shoot after the attack.

In the piece of Willow stem before me, taking the half circumference of the split stem, one inch in diameter, there are four large orifices to tunnels in a length of four inches. The holes themselves are about a quarter of an inch across, but the discoloration and injured state of the surrounding bark makes them very conspicuous. Each hole is in a small brown tunnel-shaped cavity apparently formed by gnawing, and round each external orifice is a slightly raised border of brown bark, forming (for much of the circumference) a thoroughly defined ring of about an eighth of an inch in width; at the other part the border is of much greater size. It is irregularly enlarged to a brown patch of nearly three-quarters of an inch in length from the orifice, and of varied and irregular width, up to as much as half an inch or more, and along the centre of this enlarged part the bark is split into an irregular fissure. The figure given by Dr. Bernard Altum accompanying his notes on the attack of this *C. lapathi* gives a good idea of the appearance of these rings of injured bark.*

Within these tunnels the larvæ turn to pupal state, and thence to the developed beetles; but how long the period may be that is required for the transformation is a point on which different opinions are expressed by the two well-known German writers to whom we are indebted for *detailed observations* of the life-history.

Dr. Taschenberg † considers that *customarily* the generation *is of one year*, the larvæ being to be found in August, and completing development before winter, but still that this is not always the case.

Dr. Bernard Altum (see reference below) states that the larval attack is in two distinct parts. Firstly, that of the superficial attack under the bark in the first summer; and *after* hibernation, the second stage of attack into the sound wood occurs in the second summer. "Consequently these insects have a *two years' generation*" (B. A.). Very minute details will be found given in the papers referred to, but I believe the above is sufficient for general purposes.

Prevention and Remedy.—Examining whether signs of infestation are present in the stems, and, if so, cutting down (so far as is possible) all that show presence of it, and burning them, before the beetles are

* See 'Forst-Zoologie,' von Dr. Bernard Altum, vol. iii., Insekten, pt. i. p. 208.

† See 'Praktische Insektenkunde,' pt. ii. p. 161.

sufficiently developed to have emerged—from August onwards. Where the attack is prevalent to any important degree, it would also be desirable to split some stems longitudinally during late winter or early spring to ascertain whether larval attack is present. We may need more information on this head.

Where beetles are seen numerously on leafage, beating down would be a good remedial measure. In Canon Fowler's 'British Coleoptera,' vol. v. p. 329, he mentions that "the perfect insect appears to be to a certain extent crepuscular, and that he has found the males and females together in numbers in an Osier bed near Repton, Burton-on-Trent, at half-past four or five on a summer's morning; but they appeared to be scarce in the middle of the day, or in the afternoon in the same locality." It would therefore be well, as in the case of beating down Chafers, to make sure at what time the beetles are to be found, and then, if shaken on to tarred cloths, or into pails with some mixture that they could not escape from arranged for them to fall into, probably great numbers could be got rid of.

SHORT NOTICES.

In this, the first part of my Second Series of Observations of Injurious Insects, I have varied from the original plan of arrangement, by giving, under the above heading of "Short Notices," such isolated notes on appearance, habits, treatment, or remedial measures, of insects previously referred to, as convey additional serviceable information to that of the detailed and illustrated observations, given at length in my previous series of Twenty-two Annual Reports.

Thus we secure notes of interest, which in due time may be used for completion of the previous observations, without repetition of matter which is unnecessary to the regular recipients of my Annual Reports; and to others, who may wish to study the subject *in extenso*, is procurable by means of the references to Annual Reports,* in which the chief observations have been given which are appended to each notice.

APPLE.

Eye-spotted Bud Moth. *Tmetocera ocellana*, Schiff.

The caterpillars of the Bud Moth do much harm in America by feeding on the leaves and buds of Apple and other fruit trees, whilst still in early state of growth, and spinning them together. Until the past season I had only received a single report of observation of this attack, but now, however, it seems desirable to draw attention to it, partly because just a few notes of its *demonstrable* presence were sent me, and partly because an idea was to some degree prevalent that much mischief in various fruit gardens and plantations was attributable to this cause.

On April 23rd I was favoured by a communication from Mr. W. E. Bear that he had found brown caterpillars on trees in his garden at Highgate which agreed so precisely in appearance and method of

* See advertisement of Index to twenty-two preceding Reports on, wrapper.

working with those of this infestation that there was no reason to doubt their identity. He noted them as "dreadful pests."

On April 27th I had a note from Mr. Cecil H. Hooper, of finding the attack in his orchard at Highlands, Swanley, Kent, and as he mentioned that he "saw lots of it in Nova Scotia" in the previous year, this also is presumably an accurate identification.

A third observation, which I believe to have been quite correct, was sent me on April 28th from Charsfield, Wickham Market, Suffolk, and in this instance a good supply of caterpillars were sent me for identification.

A list of about a dozen places was sent me where this Bud Moth attack was believed to be the cause of mischief present on fruit trees; but, as I had neither details nor specimens of the attacked and infested young leafage or buds for technical examination, I am wholly unable to offer a trustworthy opinion on the matter. This more particularly as there is another attack, that of the very small reddish or brownish caterpillars of the "Pith Moth" (*Laverna atra*), which, though it differs from the above in *method* of damage (as this is carried on by working up the centre of the stems just below the bunches of Apple blossom), yet to some degree has a resemblance in its *effects*. The bunches of budding blossoms and of young leaves are to be found withered and destroyed by effects of the Pith Moth attack, though not spun together, as with that of the Bud Moth.

It would probably be very useful to Apple growers to know more about these attacks, and especially whether that of the Bud Moth is really prevalent, and, if I should be favoured with specimens, I would gladly give full attention and report to the senders. But I would earnestly beg that they would let me have some samples of the spun-together or injured state of the young leaves and blossom buds, for it is an absolute impossibility to identify from a caterpillar or two, perhaps not a quarter of an inch long, and in unnatural conditions very likely affecting the colours.

The following notes convey a short description of the history during the year of the Bud Moth infestation.

About August or September the little caterpillars, which are then not more than the sixth of an inch in length, desert the leaves of the Apple or other trees on which they have been feeding, and, creeping to the twigs, spin silken cases in which they pass the winter.

In spring the caterpillars, which are of a brown colour, with nearly black head, and black plate on the next ring, come out of their cases and proceed to eat into the nearest swelling and opening leaf-bud, or possibly they time their attack a little later, when the buds are about half opened, and feed on the central expanding leaves and flowers, tying them together with their silken threads. At this stage of attack the brown colour of the injured and spun-up leaves is a guide to the nature of the mischief that is going forwards.

The caterpillars continue to feed for about six or seven weeks, and when full grown, when they are about half an inch long and slightly hairy, spin up a shelter of one or more leaves or pieces of injured leaves, which they line with silk, and in their separate "nests" they turn to chrysalis state, from which, so far as noticed with us, the moths come out between June 8th and 20th.

The little moths are only about half an inch or rather more in the expanse of the fore wings, and are of a general ashy grey colour, with a broad white band or blotch across the fore wings, whence the name of the "Eye-spot" Bud Moth. Egg-laying is considered to begin, *on the leaves*, in about three or four days, and hatching to take place in rather more than a week afterwards, when the caterpillars proceed to feed on the leaves (commonly on the under side), and, before the fall of the leaves, desert them (as above mentioned), and, removing to the twigs, spin their winter cases.

The best method of prevention is breaking off and burning the bunches of destroyed and spun-up leafage and buds; but if this attack has really become prevalent, it can be very easily recognized by the above description, and I would gladly attend to any enquiries sent with specimens of the injury. (See 'Report of Observations of Injurious Insects' for 1889, pp. 81–84; and for 1898, pp. 5–9.)

BEECH.

Beech-bark Felt-scale. *Cryptococcus fagi*, Baerensprung.

This infestation appears in the shape of a white felt-like or flocculent coating, to be found on bark of Beech trees, sometimes as a mere film, but characteristically in a coating up to as much or more than an eighth of an inch in thickness, formed of aggregations of white irregular lumps, giving the general appearance of rough lumpy white-wash having been thrown at the tree, and sometimes protruding through small cracks in the bark.

Within this soft white matter the little *Coccids* may be found numerously present, lying sometimes singly, sometimes several near together. They are soft-bodied, of some shade of yellow varying from pale to reddish yellow, and so exceedingly small (not being at the largest size as much as half a line in length) that their details are not observable by the naked eye. With a good magnifier the females will be seen to be almost circular in shape, with markings on the fore-part of the abdomen hardly discernible; antennæ a mere stump; first and second pairs of legs wanting, and the third pair merely a papillar stump. Eggs are to be found in process of laying in June, probably much earlier, as I have found larvæ present on July 4th. In larval state they are found with the abdomen distinctly segmented; antennæ five-jointed; and legs strong, the thighs as long as the shank and foot.

The possession of a *rostrum* or *proboscis*, by means of which the *cocci* suck away the juices from the trees, is a very important part of their structure. They belong to the division which includes the "Scale Insects," but are more nearly allied to the soft fleshy kind known as the "Mealy Bug," than to those which (like the Mussel Scale of our Apple trees, for instance) are covered by a horny "scale."

The infestation is widely distributed in England, and where it is allowed to establish itself is very destructive to Beech trees, singly or collectively, as in Beech woods, and in the past season I had two notes of the application of paraffin acting very well as a remedial measure.

On April 8th Mr. J. Lansdell, writing from The Gardens, Barkby Hall, near Leicester, informed me that the Beech trees in that neighbourhood were very badly attacked by this Felt-scale (of which he enclosed specimens) and many of them had been killed. In order to save a large Copper Beech which had been badly attacked, Mr. Lansdell made a paraffin emulsion, of two pounds of soft soap to a quart of paraffin, diluted with twelve gallons of water. This was *taken up the tree above all the insects*, and the branches and stem thoroughly washed with it (applied by a new scrubbing brush). This (which was done about five years ago) completely destroyed all the insects, and the tree continues quite healthy. The tree being a very fine one with many large branches, the work took one man nearly all one day, but Mr. Lansdell estimated that in the case of ordinary forest trees a man could clean four in a day; the cost of this would be worth while, as set against the serious losses of full-grown Beech in Beech woods, consequently on infestation by the Felt-scale.

On January 22nd of this year (1900), Prof. P. Hedworth Foulkes, writing to me from the College, Reading, mentioned that in the course of August in last summer he had a case of several Beech trees which it was an object to save, being infested by this "Felt-scale." These he treated by having them dressed as high up the stem as possible (by a whitewash brush) with paraffin, and the following day done over with clean water. The dressings proved a complete success, and the bark was in no way injured. Prof. Foulkes examined the trees within a week, and again a fortnight before date given above of his letter to me.

The above recipes may probably be of service as a means of stopping spread of this destructive attack, more especially as from the "felty" or flocculent secretion of the insects being, so far as we know, quite *insoluble* in water, it may be presumed that application of water without some addition which would either poison the insects or destroy their shelters by adhering to the "Felt" (as of soft-soap, for instance) would be useless.

I should, however, think that, unless under very special circumstances of thickness of bark, or under very careful superintendence, the emulsion of soft-soap and paraffin was safer than that of paraffin undiluted.

For account of *Cryptococcus fagi*, with reference to writings of Continental and English specialists, see my Twenty-first Annual Report, pp. 6–10.

CAUSTIC ALKALI SOLUTION.

Winter Spraying Application for Bark of Fruit-trees.

On April 8th of the past season I was favoured by Mr. A. Ward, Head Gardener to the Lady Emily Foley (The Gardens, Stoke Edith Park, Hereford), with the following recipe for a caustic alkali solution, which he mentioned as being found by fruit-growers to be of great service in ridding fruit-trees of many of their insect foes. I am not personally acquainted with the action of the application, but, the recommendation coming from such a known horticulturist, I have no doubt that it is serviceable, and, if used according to Mr. Ward's directions, *safe*. Still, as operators are not always careful what they are about, a suggestion of care as to such a powerful solution possibly doing injury if settling on young shoots may not be out of place, and I have also italicised Mr. Ward's direction that the water should be *boiling when used in mixing* the ingredients, as this is an important point. Mr. Ward's communication is as follows:—

"The principal ingredients are crude potash (pearlash) and caustic (commercial) soda, and these chemicals should be of the best quality obtainable. The way to make the wash is as follows: take one pound of caustic soda and one pound of caustic potash, and place in separate buckets or tubs, and pour on sufficient *boiling* water to dissolve them. Then add the two solutions together and dilute with sufficient hot water to make ten gallons, when it is ready for use. This may be applied to Apple, Pear, Plum, and Cherry trees, also Gooseberry and Currant bushes. For Apricots, Peaches, and Nectarines a weaker solution, or one pound each of the chemicals to twelve and a half gallons of water had better be used, although I have used it full strength on these without harm resulting.

"The best time to apply it is when the trees are in a *dormant state.* All insects, together with their eggs, larvæ, chrysalids, scale (whether brown or the mussel species), and any aphides which may be hibernating in the rough bark of the trees, are killed off by its action, also lichen and moss, and the wood is left quite bright and polished in appearance. The solution should be applied in the form of a spray, with a knapsack pump, or a Stott sprayer, fixed on the end of the branch attached to the tube or hose of a garden engine. Every part of the tree should be well wetted with it, paying particular attention to the stems—the rougher the bark the greater the need —and forcibly drive it into every crevice. Choose a fine still day for applying it, as windy weather results in much of the wash being lost.

"The person applying it should wear leather or indiarubber gloves on his hands and a suit of old clothes, as the spray being so caustic burns the skin, and would also soon spoil good clothes. For the same reason the operator should not allow the spray to blow in his face, and when mixing he should not hold his head over the buckets, as the ingredients boil violently for a few minutes. If these few simple precautions are taken it is perfectly safe to use, and does an immense amount of good. Where large quantities of wash are required, the ingredients may be placed together in a copper holding the required quantity of water, and afterwards boiled until the chemicals are dissolved, when it would at once be ready for use. However hot the wash may be, the spray is quite cool by the time it reaches the trees; the force with which it is driven out, and the fact of its coming in contact with the air bringing this about, so that there is nothing whatever to fear in this direction. I have used it now for several years past, and it has effected an immense amount of good on the fruit-trees at Stoke Edith."—(A. W.)

DEER.

Red-bearded Bot Fly.

Cephenomyia rufibarbis, Meig., Brauer, and Schiner.

This is a large handsome fly, about three-quarters of an inch in length, of a very broad rounded make, the colour chiefly black or brown, variously marked and intermingled with reddish, olive brown, and white hairs, the hairs themselves being sometimes parti-coloured, and so hairy altogether as to appear clothed with fur. The body between the wings has a cross-band behind the head of tawny or olive brown above, lighter at the sides, and ending in a patch of very light hairs beneath the insertion of the wings. Abdomen with the fore part with blackish yellow, fox red, or gold-brown hairs; legs black with brown shanks; wings broad, about half inch an long, with blackish brown veins, and the lower part of the wings sometimes brownish. There appears to be a good deal of difference in colour in different specimens, but one marked characteristic is that the cheeks and mouth parts are so thickly clothed with red hair as to appear like a *red beard running round the under part of the face*, from which the fly takes its popular English as well as its scientific specific name.

The species is parasitic in maggot state in the nostrils, throat, and mouth parts of the Red Deer. The flies lay their living maggots about the early part of the summer at the opening of the nostrils of the Deer, up which they work and travel onwards to the throat, adhering by their mouth-hooks. Early in March (or till April) they leave their host by dropping to the ground from the mouth or nose, and seek some dark shelter where they change to chrysalis condition, from which the fly appears in May or onwards until July, or possibly later in Britain, as the above notes are the dates of German observation. The specimens which have been kindly sent me by Mr. Dugald Campbell, Strathconan Forest, Muir of Ord, Ross-shire, N.B., were forwarded me early in June, 1896, and early in July, 1899.

We have no notes as yet (so far as I am aware) of the attack being injurious to us, but it is of some interest as having been unknown in Britain until 1894, when specimens were captured in Strath Carron, on the west of Ross-shire, N.B., only a few feet above high-water mark, and the species was also captured by Mr. L. W. Hinxman in the Cairngorm Mountains, in the county of Banff, in 1895.

In the past season the specimen sent me by Mr. Dugald Campbell, writing from Muir of Ord on Aug. 2nd, was accompanied by the note: "About three weeks ago, while sitting at an altitude of nearly three thousand feet above the sea level, a fly came and rested upon my head, which I unintentionally killed in the capture."—(D. C.) The specimen proved to be of "The Red-bearded Bot Fly," and in the case of a species which has a capacity for being injurious, but which has been so recently noticed as present with us, and is still so little reported, it may be of interest to give an observation of its presence at the great altitude named.*

STRAWBERRY.

Ground Beetle, Bat Beetle. *Harpalus ruficornis*, Fab.

A few observations were sent me from Norfolk and Suffolk during the past season of presence of Ground Beetles; an attack which was first noticed as injurious to Strawberry fruit at Woodborough, in Nottinghamshire, in 1894, and since then has become much more

* Reference to the paper by Mr. Percy H. Grimshaw, F.E.S., published in 1895, in 'Annals of Scottish Nat. History,' and of exhibition of specimens by him at meeting of Ent. Soc. in London, March 4th, 1896, will be found, with information on this infestation and figure from life, in my Twentieth Annual Report, pp. 56–59.

widely prevalent as a seriously destructive attack to both ripe and ripening Strawberry fruit, especially where grown in considerable areas for market supply. The three most common kinds are black strong made beetles, with strong biting jaws, long legs, and long horns, and from half an inch or rather more to about three-quarters of an inch in length, and of a somewhat flat and oval shape. The *H. ruficornis* is distinguishable by the legs and also the *horns* being usually red (whence the name of *ruficornis*); also by the wing-cases (so long as the specimens have not been rubbed) being covered with a thick yellowish or greyish down. Beneath the wing-cases there *are powerful wings*, which are *not* possessed by either of the other kinds. For this reason the *ruficornis*, which has a habit of transporting itself on the wing in numbers sufficient to be described as swarms on summer evenings, has a power of being much more troublesome than the others; of these the *Pterostichus* (= *Omaseus*) *vulgaris* is a little larger than the foregoing, sometimes nearly two-thirds of an inch in length, and is wholly black and shining.

The *Pterostichus* (= *Steropus*) *madidus* may be as much as three-quarters of an inch in length, and is also black, unless the legs have red thighs, and also wingless, but distinguishable by the hinder edge of the fore body being a good deal narrower than the wing-cases. There is a smaller species, *Calathus cisteloides*, which is also injurious to Strawberry fruit, which is black with brownish red legs and horns, and has the wings wholly absent or imperfect, but this species is only from a quarter to half an inch in length, and is not as frequently reported as hurtful as the other, and especially as the winged kind *ruficornis*.

The method of attack is for the beetles to be under the earth round the Strawberry plants by day, in cracks in the ground or having holes and runs through the earth and litter; and after dark they come out and feed on the Strawberry fruit. Ripe or unripe are both liable to attack, which often is carried on by eating off the surface of the fruit or portions of it, or by clearing away the seeds or (in the case of the ripe fruit) by sometimes eating holes deeply into the substance of the berry.

It was not until July, 1898, that any serviceable practical method was reported of keeping the seriously destructive ravages of the beetles in check, but in that month, on the 19th, Messrs. Laxton, of Bedford, were good enough to inform me that they had almost entirely destroyed the beetles by the following plan:—"We purchased a large quantity of cheap pudding basins early this spring; these we let into the ground, level with the surface, at distances of a few yards apart, and kept them baited with pieces of 'lights' and sugar-water. When the weather was dry we often caught half a basinful of a night, until the number gradually diminished to two or three, and now none at all." The above note not only shows the success of this simple plan, but also the vast number of beetles present, when they could be often caught in "half-basinfuls." Another method by which "*enormous numbers*" of the beetles were caught at the Woburn Experimental Fruit Ground was by obtaining a number of empty condensed milk tins, and, after placing about half an inch of tar in the bottom of these, plunging them in the soil by the plants level to the rims.

Another simple method of trapping, by turning the habits of the beetles as carnivorous as well as fruit feeders to account, is placing pieces of "flesh covered by pieces of thick sacking" amongst the Strawberry plants, which attract the beetles, and thus many are caught and killed. The smell of the meat, however, in the hot weather usually accompanying the season of Strawberry ripening might be objectionable.

The specimens sent with observations of attack to Strawberries last season were entirely of the winged Ground or "Bat" Beetle, *Harpalus ruficornis*, but are unnecessary to give *in extenso*, as they only refer again to points such as the destructiveness and the method of the attack to the Strawberry fruit, which has previously been fully noticed. See my Annual Reports for 1894, 1895, 1897, and 1898.

In one instance mention is made of beer and sugar being successfully used as a bait in basins sunk in the ground, but, as the nature of the attack does not appear yet to be generally known, it has appeared worth while to refer to it again.

Another kind of attack—namely, that of what are popularly known as "Daddy Longlegs" grubs, scientifically the larvæ of *Tipula oleracea*, and also of *T. maculosa*—was reported as attacking Strawberrry roots, and will be found noticed under the above heading—"Daddy Longlegs" —at pp. 29–31 preceding, as the infestation attacking several kinds of crops it is most convenient for reference to place the observations together.

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TWENTY-FOURTH REPORT.—SECOND SERIES, No. 2.

OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS

DURING THE YEAR

1900.

WITH METHODS OF

PREVENTION AND REMEDY.

BY

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PREFACE.

In the past season almost all of our injurious insects which are usually present have been represented, and some to a serious extent locally, or over small districts; but I am not aware, either from reports to myself or from notes in the agricultural Press, of there having been general prevalence of any special infestation.

A few kinds of insects not previously noticed (or exceptionally noticed) as British were recorded, as also some amount of bad attack to crops not usually subject to this from the special kinds; likewise, from specimens and observations contributed, material has been given for practically useful addition to life-history of several injurious infestations.

Of direct application of remedial measures, perhaps the most important is the short note (see p. 99) of the success of use of steam spraying apparatus in orchard culture; the observations of good success by treatment (specified) in preventing recurrence of attack of Pear Gnat Midge (see pp. 63–69) are also important.

In regard to crop insects not previously recorded, I draw attention to three species of Bean- and Pea-seed Beetles in a cargo imported from Smyrna. As our two previously well-known kinds are also Asiatic, I thought it might be useful to draw attention in time to the newcomers, and at pp. 24 and 25 I give figures of the five kinds, placed side by side, with plain descriptions added, by which I hope (should new infestation arise) the cause may be recognized. The Silver Y- or Gamma Moth is a most common kind, and its "half-looper" caterpillars general feeders, but I am not aware of it having been recorded as attacking Mustard, or, with some small exception (in the year 1892), Potato leafage (see pp. 53–58). I conjecture this attack to have been windborne. The "Cabbage Moth," also very common and chiefly infesting Cabbage, was fully reported, with specimens accompanying, as occurring to such an injurious extent in caterpillar state for at least two successive years on Pea leafage at a locality in Aberdeenshire, that it appeared well to record it (pp. 103–105).

Amongst orchard pests the presence of a small Tortrix moth with life-history which, as far as I am aware, had not previously been recorded as troublesome here, was kindly contributed, with specimens for illustration (see pp. 73–78); and I was myself able to add some needed material to the life-history of the Pith Moth (see pp. 1–8).

Some additional and useful information has also been gained regarding the two kinds of *Hylesinus*, known as the "Common" and the "Greater" Ash-bark Beetle.

On the whole, I believe I may say that the past season has brought not only an increased number of enquiries, or communications, regarding a larger number of infestations than are usually the subject of correspondence, but also that we have made a fair advance in information.

The following list gives the names of most of the kinds regarding which I was consulted; but it should be observed *that, so far as I am aware from reports sent to myself*, there was no general infestation on orchard leafage of the caterpillars of the Winter Moth and allied species, nor in late summer and autumn of what are often known as Turnip Grubs, or "Surface Caterpillars," the larvæ of *Agrotis segetum* and other allied kinds often very destructive to Turnip bulbs, &c.

Regarding corn pests, the only kind as to which I have had special enquiry was that of Wheat-bulb Maggot, and on careful search through my books I have not been able to find a single entry of enquiry as to Hessian Fly. This, of course, does not at all prove the pests were not troublesome; still, I conjecture it is likely that, if they had been prevalent to any important extent, some amount of application regarding them would have been sent to myself.

I give on opposite page a list of most of the infestations noticed in the past season.

Beetles (*Coleoptera*).

Ash-bark Beetle, Common, *Hylesinus fraxini*	In Ash trees.
,, ,, Greater ,, *crenatus*	,,
Asparagus Beetle, *Crioceris asparagi*	Asparagus.
Bone (Larder) Beetle, *Dermestes vulpinus*	Bones and Wood.
Chafer, Rose, *Phyllopertha vulgaris*	Leafage, Roses, & Grass roots.
Cockchafer, *Melolontha vulgaris*	,, and crop roots.
Flea Beetle, Hop, *Psylliodes attenuata*	Hop cones and leaves.
,, Turnip, *Phyllotreta nemorum*	Turnip leaves.
Ground Beetle, *Harpalus ruficornis*	Strawberry fruit.
Pea and Bean Beetles, *Bruchus brachialis*	Pea and Bean seed.
,, ,, ,, *pisi*	,, ,,
,, ,, ,, *rufimanus*	,, ,,
,, ,, ,, *rufipes*	,, ,,
,, ,, ,, *tristis*	,, ,,
Pine Beetle, *Hylurgus piniperda*	Pine bark and shoots.
Plum-bark Beetle, *Scolytus pruni*	Plum bark.
,, Wrinkled, *Scolytus rugulosus*	,,
Weevils, Granary, *Calandra* (*Sitophilus*) *granaria*	Stored grain.
,, Rice, ,, ,, *oryzæ*	,, Rice, &c.
,, Pear-shaped, *Apion nigritarse*	Clover, and on Plum.
,, Pine, *Hylobius abietis*	Young Pine bark.
,, Vine, *Otiorhynchus sulcatus*	Vine (& other) roots & leaves.
Wireworm of *Lacon murinus* (large species)	Grassy places, Garden refuse.

Butterflies and Moths (*Lepidoptera*).

Cabbage Butterfly, Large White, *Pieris brassicæ*	Cabbage leaves.
,, Moth, *Mamestra brassicæ*	,, and on Peas.
Clearwing Moth, *Sesia tipuliformis*	Currant stems.
Codlin Moth, *Carpocapsa pomonella*	Young Apples.
Diamond-back Moth, *Plutella cruciferarum*	Turnip leaves.
Eye-spotted Bud Moth, *Tmetocera ocellana*	Apple buds and leaves.
Gamma Moth, *Plusia gamma*	Mustard & Potato leaves (exceptional).
Ghost or Swift Moth, *Hepialus lupulinus*	At roots.
Goat Moth, *Cossus ligniperda*	In timber trees.
Gooseberry & Currant Moth, *Abraxas grossulariata*	Gooseberry & Currant leaves.
Hawk Moth, Death's-head, *Acherontia atropos*	Potato leaves.
,, Eyed, *Smerinthus ocellatus*	Apple leaves.
,, Poplar, ,, *populi*	Poplar leaves.
,, Privet, *Sphinx ligustri*	Privet and Lilac leaves.
,, Striped, *Deilephila livornica*	Vine and Fuchsia.
Leopard Moth, *Zeuzera æsculi*	Wood of various trees.
Raspberry-stem Bud Moth, *Lampronia rubiella.*	Raspberry flowers & leaf-buds.
Tortrix Moth, Pine-shoot, *Retinia buoliana*	Pine buds and shoots.
,, Orchard Tree, *Penthina pruniana*	Young leaves, &c.
,, Mottled Fruit Tree, *Penthina variegana*	Clusters of buds, &c.
,, *Tortrix ribeana*	On Currant, Gooseberry, &c.
Winter Moth, *Cheimatobia brumata*	Orchard leafage.

Two-winged Flies (*Diptera*).

Daddy Longlegs, *Tipula* sp.	Roots of Grass, &c.
Frit Fly, *Oscinis frit*	Young Oat plants.
Gad Fly, Autumnal, *Tabanus autumnalis*	Animals.
Horse Bot Fly, *Gastrophilus equi*	Horses, internally.
Horse Forest Fly, *Hippobosca equina*	Hair of horses and cattle.
House Fly, *Musca domestica*	In houses.
Pear Gnat Midge, *Diplosis pyrivora*	Young Pears.
Ox Warble Fly, *Hypoderma bovis*	Hides of cattle.
Sheep's Nostril Fly, *Œstrus ovis*	Nostrils of sheep.
Sheep Tick (Ked), *Melophagus ovinus*	In fleeces of sheep.
Wheat-bulb Fly, *Hylemia coarctata*	Young Wheat plants.

Sawflies, &c. (*Hymenoptera*).

Gooseberry and Currant Sawfly. *Nematus ribesiæ* .	Gooseberry & Currant leaves.
Sirex, Giant. *Sirex gigas*	Pine timber.
,, Steel-blue. *Sirex juvencus*	,,

Aphides, Scale Insects, &c. (*Homoptera*).

American Blight, Woolly Apple Aphis. *Schizoneura lanigera*	Apple bark.
Apple-suckers. *Psylla mali*	Stems of blossom-buds.
Scale, Apple, Oyster Scale. *Mytilaspis pomorum* . . .	Apple bark.
,, Beech Felt. *Cryptococcus fagi*	Beech bark.
,, Currant. *Lecanium ribis*	Bark.
,, White Woolly Currant. *Pulvinaria ribesiæ* . .	Currant bushes.

Besides communications, or enquiries, sent regarding the above infestations, information was asked about other insect troubles—as of Fleas, Ants, and Cockroaches, for instance—of which it was impossible from want of details and of specimens to tell the species certainly.

Of crop attacks of other kinds there was again as usual enquiry about "Tulip-root" in Oats, which is present every year, though much might be done to prevent it; also of "Onion-bulb Disease," and also Bean-stem Disease, caused by the Stem Eelworm, *Tylenchus devastatrix*.

Of Mites (*Acari*, scientifically), *Tyroglyphus longior* was reported at Ham; and *Phytopti* (distinguishable from other kinds of Mites by their narrow cylindrical shape, and by possessing two pairs only of legs appended near the head extremity) were also present. Of these, the Pear-blister Mite, *Phytoptus pyri* (so called from its habit of feeding between the two sides of the leaf, and thus causing blisters), may easily be kept in check; but the Black Currant Gall Mite, *P. ribis*, continues to cause much mischief.

I have again added a notice of the "Flatworm," *Bipalium kewense*, as, by the courtesy of Dr. J. Stewart MacDougall (Entomologist of the Royal Botanic Society, Edinburgh), I was favoured with notes of his personal observations of this "Planarian," feeding on Earthworms, which is an important addition to our former knowledge of the habits of this very peculiar "worm."

Much communication regarding ordinary insect attacks, and also on co-operation in serviceable ways of spreading knowledge of *practicable methods* of lessening amount of farm and orchard insect pests in this country has taken place; correspondence also on entomological subjects continues fully up to amount of previous years, with the heads of departments in our own Colonies and on the Continent of Europe.

But now, although with much regret, I am obliged to say that I feel the time has come for discontinuing this series of Annual Reports.

When I commenced the work in 1877 comparatively little was known of the habits and means of prevention of insects seriously injurious to our crops, and of this little a very small amount was accessible for public service, and I undertook the series of Reports in the hope (so far as in my power lay) of doing something to meet both these difficulties. Firstly, by endeavouring to gain reliable information of the kind needed; and secondly, by publishing this, with all requisite additions, and especially with illustrations, at a price far below the publication expenses, so that it might be accessible to all who wished to purchase, but especially by sending a copy of each Annual Report to each contributor who had favoured me with useful information. It seemed to be but right and fair that those who kindly helped in the work should have their courtesy acknowledged to the best of my power, and I have continued the reciprocation throughout.

But the work was hard; for many years for about five or six months all the time I could give to the subject was devoted to arranging the contributions of the season for the Annual Report of the year, with addition of the best information I could procure from other sources (in every case, whether of contributors or otherwise, *fully acknowledged*). As the consultation enquiries were kept up during winter as well as summer, I found the work, carried on single-handed without the help of a staff, at times very fatiguing. But so long as there appeared to be a call for it, I have tried to do what I could.

Now, however, the *necessities* of the case have (as matter of course) been gradually changing. Year after year information has been sent, gradually completing *most* of the histories of *most* of our worst insect pests, and now additional information is rarely (as is to be expected after twenty-four years' observations) on points of great agricultural importance.

I claim no credit to myself in the work; but those who will look over the names of the contributors given with their information will see how deeply indebted I am to them, and to other good friends, who have placed their experience and great knowledge at the public service.

To them, and to all who have assisted me, and to some who have allowed what began as agricultural communication to ripen into valuable friendship, I offer my grateful thanks and my deep appreciation of their goodness, and I trust they will believe that if, as I well know, much of my work has not been as well done as it would have been in better qualified hands, at least I have earnestly tried to do my very best.

ELEANOR A. ORMEROD, LL.D.

TORRINGTON HOUSE, ST. ALBANS:
March, 1901.

List of Injurious Insects, &c., noticed in this Report.

SHORT NOTICES.

* "Pocket Plums"—a fungoid attack; for reason of insertion, see p. 78.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

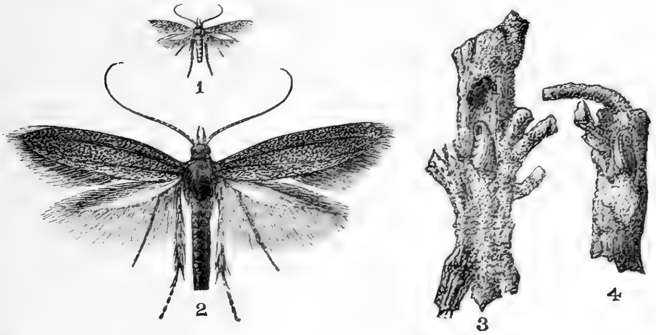
COMMON CROP PESTS

DURING

1900.

APPLE.

Pith Moth. *Laverna atra*, Haw.; *L. hellerella*, Dup.



Laverna atra.—1 and 2, moth, natural size and magnified; 3, chrysalis in tunnelled shoot, magnified; 4, chrysalis in bud.

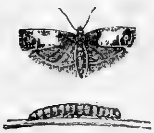
During the past season the presence of Pith Moth caterpillars was reported as much more injurious than in any previous year. In 1889 enough observation was sent to me to show its presence in the country, in one locality near London; in 1898, observations were sent from the same locality of the effects of the attack being noticeable; and from Southport, Lancashire, and from New Cross, on the edge of Surrey and Kent, I had information of what was, in the first case, certainly presence of this *Laverna atra*, and in the second, apparently so, as injurious to clusters of Apple blossom buds by tunnelling of the stem just beneath them. But in both instances the damage was only mentioned as a personal observation of the writer's, not as a trouble of the neighbourhood.

In the past season much more serious complaints of presence of the attack were sent me from near Worcester, also from near Ross, in Herefordshire, and from Polegate, Sussex, thus showing a greatly extended area of infestation. And with regard to amount of mischief occasioned: this was mentioned by my Worcester correspondent "to be causing considerable injury to the Apple trees in this county"; by my correspondent at Polegate, Sussex, as being to an extent which had obliged him to cut off quite two bushels of infested twigs from about a hundred and thirty trees, and that he also noticed the pest, "which has increased to a very great extent this year," in an orchard about a mile and a half off; from near Ross the specimens were sent with the remark accompanying, that "it appears to me a very serious pest, and I am afraid, judging from this neighbourhood, that it is on the increase."

It is somewhat interesting to notice how, in the present state of advance of horticultural observation, an attack like this, or, again, that of the Pear Gnat Midge, can be brought into notice for identification and application of preventive measures on its first appearance, and (*where these are carried out*) the establishment of the pest be to a great degree prevented.

The mischief caused by the Pith Moth caterpillars may be easily known by the cluster of blossom buds and leaves drooping and dying, consequently on the caterpillar having bored up the centre of the shoot immediately below them. This characteristic (that is, the clusters drooping and perishing) should be particularly noticed, for thus the attack may be distinguished from that of the caterpillars of the "Eye-spotted Bud Moth," in which the grubs work amongst the opening blossom and leaf-buds, and *tie them together* (see note).* The "Pith

* In this case, although it appears that the caterpillars *may at times* tunnel along the centre of the shoot, the regular course of life is for them to work in the opening leaf and flower-buds, and presently tie the central leaves and flowers together with silken web, in which they turn to the chrysalis state, and from which the moth has been recorded to come out in this country during the second and third week in June. The eggs are laid shortly after on the Apple leaves (sometimes on leaves of other fruit trees), and soon after hatching the caterpillars begin to feed on the skin of the leaf, usually on the lower side. Towards autumn the caterpillars remove to the twigs, where they spend the winter in silken spun cases, and in spring come out from them to attack the opening buds. See my own Annual Report for 1898, with references to European and American writers on the attack; and especially to the excellent paper entitled 'The Bud Moth,' by Prof. M. V. Slingerland, Assistant Entomologist, Cornell University, Agricultural Experiment Station, Ithaca, N.Y., U.S.A., pp. 57–65.



TMETOCERA OCELLANA. Eye-spotted Bud Moth and caterpillar.

Moth" caterpillars (those under consideration) work *in the pith*, but do *not web the blossom-buds and leaves together;* and they turn to chrysalis state either in the very short tunnels which they have hollowed out, or at the tip of the workings, probably partly exposed.

The dates of appearance of the moth of which I have notes from observation in this country are the 8th of July and somewhat before and after.

The moth is only half an inch or hardly so much in expanse of the fore wings. These are narrow, and to the naked eye appear merely of a somewhat varied black or deep brown colour. When moderately magnified, they will be seen to have a very irregular white streak running along the inner edge of the wing from the base to the extremity, this being of various widths, or having two or three branches diverging towards the middle of the wing. The dark part is more or less varied with tawny, and the light with most minute specks of black; but the great variations of colouring make it almost impossible to describe it serviceably.* In three specimens which I especially examined, the right and left fore wings varied from each other to some degree in every instance, as seen by a two-inch object-glass. The fringes are grey. The hinder wings are grey, with the fringes paler. The head and face white; the horns (*antennæ*) fuscous, with paler rings. The specimens figured, natural size and magnified, at p. 1, are from Pith Moths reared by Mr. O. E. Janson, F.E.S., from infested Apple twigs.

In regard to the habits and appearance of the *larvæ*, or caterpillars, the following short note of method of infestation, taken from German observations by Herr Mühling,† is that they hybernate under the bark of an Apple twig close by a bud. In May they bore onwards into the young growing shoot, and feed on the pith (whence the name of Pith Moth). They also eat up the middle of the stem beneath the bunch of flowers, and thus cause the budding blossoms to wither and perish, even to the extent of the destruction of the whole bunch.

This description agrees excellently with the method of injury caused by tunnelling up the soft terminal portion of the shoots, of which I had a most plentiful supply of specimens sent me in the past season; and also the habit of the caterpillar of turning to chrysalis state either in its burrow or partly exposed at the end of it. And from these specimens I was able to secure a description of the larva, and likewise

* For minute description of what is considered the ordinary marking, with notes of some differences of colouring, see Stainton's 'Tineina,' pp. 239, 240.

† See observations by Herr Mühling quoted in 'Praktische Insektenkunde' of Dr. E. L. Taschenberg, pt. iii. p. 287; and 'Die Pflanzenfeinde' of Herr Kaltenbach, p. 781.

of the chrysalis, which previously I had not been able to find recorded, or to describe in detail myself.

The specimen of larva, or caterpillar, which I especially examined was lying in its tunnel beneath a bunch of buds, together with "frass," that is, the dirt and powdery results of its larval workings. The caterpillar was, as nearly as possible, a quarter of an inch in length, and, at a general view, of a brownish colour. When seen magnified, the head was darkish, black at the back; the next segment greyish above, with a light line along the middle; the succeeding segments pale ochrey, or yellowish, with a transverse band of chestnut colour above. This band was very little observable on the foremost segment, but increased in width until at about the fourth segment from the tail extremity the segments above were wholly brown; the caudal segment dark brown or black above. Spiracles chestnut colour, with slight markings of same colour beneath them. Under part of the body pale; sucker-feet dark.

In the various specimens of larvæ which I examined there was a slight difference in colouring, presumably from difference of age. In one instance in which the larva was somewhat injured in withdrawing it from its burrow, all that was noticeable was quite similar to the above. In another, the larva, which was presumably younger, was similar to the two above in colouring of head, next segment, and also tail segment; the intermediate segments *paler*, and colour along the back similar.

In about eleven tunnelled shoots which I examined, sent me from near Worcester about May 23rd, a larva was present in its tunnel in six instances.

In such specimens of attacked Apple shoots as I opened from about two dozen sent me from Polegate, Sussex, on May 28th, I found the caterpillar present in several instances, and with somewhat greater variety in size and tint of colouring. In the largest specimen the reddish colour was more generally prevalent, and the four pairs of sucker-feet beneath the body, which showed plainly, were pale or white; in a quite young specimen the four pairs of sucker-feet were only just visible.

In a supply of attacked shoots sent me from near Hereford on June 5th, I found the caterpillar present in one instance, but I did not find any chrysalids present up to this date. From the circumstance of various of the shoots from different localities which I opened having been obviously bored by the larva and deserted, I presumed that in these instances the larva had, as is its occasional habit, turned to chrysalis stage partly exposed at the outer end of its burrow, and had fallen out.

Chrysalis condition.—Specimens sent me in 1889 showed, as figured, magnified, at p. 1, the change of the caterpillar to the chrysalis condition taking place in the tunnel which it had worked out along the centre of the twig, or at the extremity of it, where the empty case is figured as partly exposed in a destroyed leaf-bud at figure 4. Figure 3 shows another specimen lying amongst the "frass," caused by its working in the tunnelled twig. The chrysalis was about three-sixteenths of an inch long, and the sheaths of the antennæ remarkably noticeable.

On June 18th, on examining the tips of some of the Apple shoots infested by this *L. atra*, or Pith Moth, which had been sent me, I found these for the most part had become dried, but in two instances contained the chrysalis.*

The specimen which I especially examined was about three-sixteenths of an inch in length; the shape cylindrical, largest across the thorax. The head of a dull red, and the back of the next segment reddish; colour for the greater part of the length of a palish tawny or ochreous tint, but reddish at the tip of the tail, with three or four reddish transverse lines dividing the preceding segments above.

Beneath, the form of the limbs showed well with the extremities of the antennæ, free, and reaching to about the second segment from the end of the tail; and underneath the body, and almost close to the extremity of the tail, were two dark-coloured short narrow processes, forming together a somewhat fork-like growth.

Another specimen of chrysalis, which was partly exposed on breaking open the tunnelled twig in which it lay, was of a similar ochreous or light tawny colour, with red tint at the head.

These specimens gave good examples of the change from caterpillar to chrysalis or pupal condition taking place in the shoot previously bored or tunnelled by caterpillar workings, as shown (magnified) at fig. 3, p. 1, taken from a specimen sent me in 1898.

The further life-history of the Pith Moth up to its development was completed by the observations sent by Mr. Lansdell, from Wyld's Green, near Worcester, on July 5th; that is, between a fortnight and three weeks from the date when I found that some of the caterpillars in Apple shoots which I was watching had turned to chrysalis state. Mr. Lansdell then wrote me that he had several Pith Moths (hatched from infested Apple twigs similar to those which he had sent me), of which he forwarded descriptions; and a few days later let me have two specimens. Of these, the moth which arrived uninjured agreed excellently in all characteristic points with Stainton's description of *L. atra*, Haw., as given in his 'Tineina,' pp. 239, 240 (also see *ante*, p. 3).

* Postal transmission and withering of the small terminal pieces of the shoots appeared to be very unfavourable to development of the caterpillars, for of those sent me few reached chrysalis state.

The above observations convey the more important part of the life-history; but, so far as I am aware, we do not yet know where the eggs are laid, or the locality of feeding of the quite young caterpillars up to the date (as mentioned by Herr Mühling (see *ante*, p. 3) of their hybernation under the bark of an Apple twig close to a bud. If we knew where they were open to attack, it would help greatly as to early preventive measures.

As this attack has been so little noticed in the *detail* of condition of the infested Apple twigs, I give the following notes, although they do little more than confirm such amount of observations as we possessed. It may be remarked in passing that the tunnels are very short, even down to less than three-quarters of an inch in length.

The first specimens of infestation of the Pith Moth caterpillar which I received in the past season were sent me on May 23rd, from "Pomona," Wyld's Lane, Worcester, by Mr. J. Lansdell, F.R.H.S., with the remark :—

"I am forwarding you some specimens of caterpillars of the 'Pith Moth'; they appear to be causing considerable injury to the Apple trees in this country."

Two days afterwards—that is, on May 25th—Mr. Lansdell forwarded me a further supply of shoots attacked by the same species of caterpillars; all of these shoots, and of those previously sent, being from young Apple trees which had only been planted in the autumn of the year 1898.

Of eleven of these shoots which I examined, all but one showed tunnellings of the caterpillar of *Laverna*—in some instances deserted, in some still containing the larva—the burrows sometimes varying slightly in length and position of the outside exit-hole (where empty), as shown in the following notes :—

Specimen 1. A slight tunnel just below blossom buds.

2. A short upright tunnel below buds, turning at almost right angles to an opening at the outside of the twig.

3. Upright tunnel below buds, with upright gnawing on one side of shoot (continuing above); this much filled with frass.

Specimen 4 was of a side bunch of buds, beneath which I found the small caterpillar in its tunnel, together with "frass," which is described at p. 4, preceding.

Terminal bud in same shoot with small deserted tunnel beneath it.

5. Gnawing beneath extremity of shoot deserted.

6. Tunnel beneath buds containing larva; this injured in extraction, but so much as remained similar to larva in No. 4.

7. Side shoot with tunnel containing larva.

8. Upright tunnel as before, about a quarter of an inch long; larva alive within.

9. Tunnel (with caterpillar within) running right up to the base of stems of Apple buds.

10. Similar to 9, and with caterpillar present.

On May 28th specimens of Apple shoots showing attack, which proved on examination to be that of the Pith Moth caterpillar, were forwarded to me by Mr. F. W. Thomas, from Wannock Gardens, Polegate, Sussex, with the following notes :—

"By this post I am sending you a box of fruit-spurs, which are attacked by some maggot. I am sorry to say the trees are very badly attacked, mostly on the young trees of seven or eight years old. I have (I am sure) cut off quite two bushels of the twigs, same as sent, from about one hundred and thirty trees. I noticed it last year, and cut off every little twig that I saw, but the pest has increased to a very great extent this year. I have also seen the same thing in an orchard about one and a half miles from here. All the specimens sent have drooped and withered since last Thursday, when I went over the trees and cut out all I could find; but to-day I find lots of shoots affected."

The specimens forwarded, of about two dozen or more shoots with clusters of Apple blossoms, proved to be very characteristic of the *L. atra* attack. The knots of blossom-buds were killed, but none of the leaves of the cluster or the ruined flowers, of which the petals were now turned brown, *were at all spun together*.

The method of injury in all the shoots which I opened resembled that of those sent by Mr. Lansdell mentioned above; but there was a greater variety in the size, and, as mentioned before, also in the tint of colouring of the caterpillars. The tunnelling appeared to be always in this year's soft growth of shoot, just below the cluster of Apple blossoms or blossom-buds.

On June 5th a further supply of injured Apple shoots was forwarded to me from Oakleigh, Ross, Herefordshire, by Mr. H. F. Getting, showing injury to the clusters of blossom-buds by tunnelling of the Pith Moth caterpillar in the shoots similar to those previously mentioned, and with the caterpillar present in one instance. Mr. Getting remarked of the infestation :—

"It appears to me a very serious pest, and I am afraid, judging from this neighbourhood, that it is on the increase."

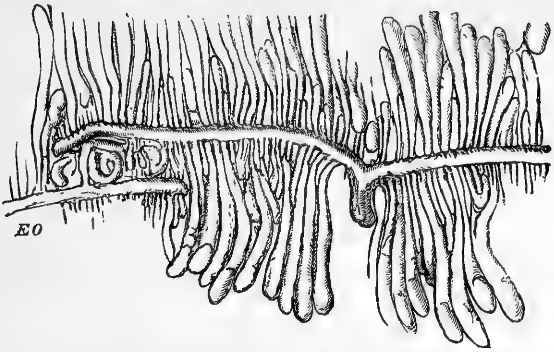
Prevention and Remedies.—So far as we know at present, our only preventive measure is to cut or break off the ends of the shoots (which the withering of the cluster of blossom-buds show to be infested), and to burn them. It is no use merely throwing them aside, for, if the caterpillar within is full-grown, or has turned to chrysalis, the moth will develop as perfectly as if the infested shoots had remained on the trees, and will fly away to do just as much mischief as if left in its natural position.

In our present want of knowledge as to where the eggs are laid and the young larvæ feed, it would help very much if any observer who could spare time for the purpose would experiment a little. We know that the moths appear about the second week in July, and if at this time infested shoots were placed so that the moths should be secured on development, and some fresh Apple shoots placed so that the moths had the opportunity of laying their eggs, we should get some useful knowledge. The Apple twigs might be placed with their stems in damp soil, or in water, under a wire gauze dish-cover (if no more elaborate method of proceeding was followed); and though the eggs are too small to be noticeable individually, the little moths are large enough to be seen hovering about the leaves or twigs, if these should prove to be the places chosen for egg-laying. If so, heavy spraying, even with water alone, or with a solution of soft-soap, or any other ordinary insecticide, applied at the time when the moths may be noticed to be most torpid, and also *not* strongly enough to hurt the young fruit, would probably do much good.

It is greatly to be hoped that attention will be given to checking this attack, for it is evidently spreading, and is very injurious, and where it is settled in a district it cannot be got under as it should be without *action on the part of all owners* in the infested neighbourhood.

ASH.

Common Ash-bark Beetle. *Hylesinus fraxini*, Fabr.



Workings of HYLESINUS FRAXINI, showing forked "mother-galleries" with larval galleries from the sides.

The *Hylesinus fraxini*, popularly known as the Common Ash-bark Beetle, does mischief by means of its white footless fleshy grubs which work in the bark of Ash trees (*Fraxinus excelsior*), and though they appear to have an especial preference for newly felled timber, yet the infestation is also to be found in decayed or sickly trees, and sometimes in young trees. In these the attack is certainly mischievous by reason of the galleries stopping the full flow of the sap; and though in felled trunks the damage is little or none, they act as regular nurseries for recurrence of attack. As the signs of the working in the bark are very noticeable during a part of its progress by the quantity of wood dust thrown out by the beetles at the commencement of their burrowing operations, preventive measures may be applied at once with little trouble or cost.

The above figure shows the very short central entrance-gallery through the bark branching to right and left into two galleries, usually of about even length. These are formed by the pair of parent beetles, the male and female; and along the sides of these tunnels, or galleries, the female lays her eggs, each in a little hollow dug out to receive it. These are laid at about even distances from each other, and are recorded as being covered with a kind of gummy material; also that the gallery is finished and the eggs laid in it in from ten to twenty days, after which both of the beetles usually die in the burrow, and the female is stated always to do so.*

* For observations on the habits and transformations of *Hylesinus crenatus*, *H. fraxini*, and *H. vittatus*, see paper by T. Algernon Chapman, M.D., in Ent. Mo. Mag. vol. v. pp. 120–123; also for specific descriptions of the above and *H. oleiperda*, see 'Coleoptera of the British Islands,' by the Rev. Canon Fowler, vol. v. pp. 417–419.

H. fraxini, Fabr., is by far the most common of our four British species. It is from two and a half to three and half millimetres in length—that is, from somewhat over a twelfth to somewhat over an eighth of an inch in length—short and convex; on the upper side pitchy, reddish, or dusky in colour, *variegated with ashy and fuscous scales;* beneath with an ashy down; antennæ rusty, with the club larger. Thorax transverse, finely and granulately sculptured wing-cases with fine punctured striæ, interstices broad, rugosely sculptured; legs black; feet red or rusty.

The figures of *H. crenatus* at the heading of the following paper give a very fair idea of the shape of *H. fraxini*, much magnified; but from this species *H. fraxini* is distinguished by *H. crenatus* being noticeably *larger*—this is as much as 4–5 millimetres in length—and also it is usually deep *black* in colour and shiny (*not* with a pattern on the beetles of dusky or lightish scales, as is the case with *H. fraxini*). From *H. oleiperda* (which is of the same length as *H. fraxini*) this may be clearly distinguished by *H. oleiperda* having usually "a band of whitish grey hairs along the suture" (W. W. F.)—that is, along the central line of meeting of the wing-cases; and *H. vittatus*, the smallest of our four British *Hylesini*, which is from 1½–2 millimetres long, is thus easily distinguished from *H. fraxini.*

Although *H. fraxini* is so common and so widely distributed, I have rarely had enquiries sent me regarding the attack; but in the spring of the year 1875, the beetles appeared in such great numbers on the trunks of some newly felled Ash trees at Osterley Park, in the neighbourhood of Isleworth, as to afford me an opportunity of watching the commencement of their boring operations, of which I give some notes from the account by myself in the 'Entomologist,' vol. x. pp. 183–187.

In this case the trees had grown to the average height, and were about a foot in diameter; they had grown (and the felled trunks were laid) in a damp locality, and the part chiefly attacked was the lower side of trunks next the grass.

The work was begun about April 19th, the beetles being then wandering in great numbers over the timber until an appropriate spot being found, and the boring commenced, the beetles continued steadily at their work, irrespective of any disturbance; the smooth surface of the bark, or any of the slight fissures, appeared to be selected indifferently by the beetles as the commencement point of their burrows.

In four days the Hylesini had disappeared, the only signs of their presence being the thrown-out matter from their borings, then in progress, inside the bark. The progress was very slow; in captivity the beetle made an advance of only half its own length in from ten to twelve hours, and in natural circumstances of rarely more than half an inch in the ten days after first observation of the beetles. Operations were begun by a single beetle drilling a circular bore just large enough to allow of its passage, where it was shortly joined by its companion—the pair presumably working together at the excavations, as the tunnel being always free of incumbrance, and occupied by both *Hylesini*, the rubbish could hardly otherwise have been passed from the hole.

At about half an inch at most from the outside entrance the tunnel forked (and pairing appeared to take place), the two new tunnels being carried on slowly to right and left, and almost at right angles with the first entrance-passage, till in about five weeks they were at their full length; the burrowings were inside the bark, so as to impinge chiefly on the bark itself, but also to leave a narrow line beneath the gallery on the outer white wood—this showing when a strip was removed to gain a sight of the progress of working. From the great amount of infestation, there was full opportunity of taking observations.

By July 4th most of the beetles were dead in their burrows, and a few of the channels of the larvæ begun, but not as yet in more than one of each pair of galleries; and about three weeks later these larval tunnels might be found completed—usually placed side by side, and at right angles, so far as circumstances allowed, of both of the side galleries which had been pierced by the parent beetles. This very regular position of the larval burrows (as figured at p. 9, magnified) is characteristic, and is in itself to some degree a preventive measure to excessive increase, for the larval galleries start so closely side by side under common circumstances as only to leave space for the grubs in the earliest stages of their existence, consequently, with increase of growth more room is needed. The strongest grubs get ahead of their neighbours, and, taking possession of the accommodation, leave the weaker ones to perish, their tunnels thinning away into nothing between the steadily increasing borings on either hand, as shown in the figure (magnified) at p. 9.

When the larvæ of *H. fraxini* start side by side from the egg, I found that thirteen might be counted to the half-inch; whilst of those which survived to the journey's end only seven found the requisite space. Occasionally a whole line of eggs, or larvæ, in their very first stage failed to progress further in their development, the shiny specks being noticeable, each in its own packing, along the side of the gallery; but without the external gummy skin which forms the usual protection of the egg-chamber projecting slightly like minute studs along each side of the tunnels formed by the parent beetles. The egg appeared *never* to be deposited by the side of the short entrance passage, and *rarely just above* the fork; the space afforded being usually occupied by *larval passages parallel* to the first, and *pupal-chambers* running close up to the second, as shown in the figure at p. 9.*

The change to pupal condition took place in cells at the extremity of the larval (or grub) tunnellings, which infringed just a little into the outer part of the wood immediately below the inner part of the bark through which the tunnellings were pierced. This change had commenced about July 24th—that is, about three months from the first appearance of the parent beetles in April; the pupæ at this date were fairly numerous in the cells at the end of the burrows, which were tightly filled throughout (down to the shiny exterior of the egg-chamber projecting into the empty main gallery) with the rejected remains of their excavations. The full development to the beetle state began about three weeks later, continuing over a lengthened period.

In the above observations, from the large amount of specimens lying conveniently for examination, I was able to trace the history forward from the first appearance of the infestation of *Hylesini* settling on the fallen Ash trunks towards the latter part of April up to the development of the beetles, which commenced about the middle of August; and as they agree in all characteristic points with the ordinary history of *H. fraxini* in this country, I have given them in this form as possibly of more interest than as simple quotation.†

In regard to the life of the beetles after their late summer and autumn change to this condition, it is mentioned by Dr. T. A. Chapman, in his excellent observations on the transformations of *H. fraxini*, referred to, *ante*, in note, p. 9, that "the perfect beetles usually remain during the winter months at the ends of the burrows formed by the larvæ, and emerge in spring to continue their ravages, leaving a very distinct circular aperture."

The above observations, it will be seen, refer entirely to the history of one brood; this being especially noticed as usually resting in beetle state during the winter at the end of the larval burrows, and (so far as I am aware) there is not any published record of *H. fraxini* being known to be double-brooded in this country.‡ But, on comparing notes of specimens forwarded to me from Llanerch, Llanelly, South Wales,

* The figure is sketched on a "rubbing" from a specimen of the galleries which I had taken in the bark from one of the trees; consequently, is almost an exact *facsimile*, showing the large proportion of larvæ which perish from want of room, and also the occasional contortions in the direction of the larval galleries, where it chanced that the "mother-gallery" of another set had been pierced across their line of advance.—E. A. O.

† See also my account in somewhat *more detailed form* in "Workings of *Hylesinus fraxini*, by E. A. Ormerod," in the 'Entomologist,' vol. x. pp. 183–187.

‡ Of course I should not like to state this as a definite fact; but, after much search, I have not been able to find reference to other than the infestation being single-brooded.

in 1882, with the observations published by Herr Eichhoff in the previous year, I find the complete difference in character of these winter tunnellings from the summer attack to agree excellently with Herr Eichhoff's description of the nature of the tunnellings which he considers to show habitat for *winter shelter of the second brood.*

He mentions,* after some remarks regarding a second brood, that it is only the second generation which bore for themselves separate winter quarters. For this the beetles gnaw each for themselves slightly waving cylindrical galleries, directed somewhat upwards in the thick bark so as *not* to penetrate into the splint, which is a very important observation, as the region between the "splint" and the "bast"—that is, the region between the outside forming wood or *alburnum*, "the splint"; and the inner part of the bark, "the bast"—is the especial locality for breeding. The length of these winter galleries, taken by measurement from Herr Eichhoff's figure, is from about three- to five-eighths of an inch.

The specimens which I received on March 16th from Llanelly, South Wales, were forwarded with some observations accompanying by Mr. Angus M'Intosh in 1882.

These were of rough thick Ash bark, just taken from living trees, bored into by Ash-bark Beetles (*H. fraxini*), which were then in their winter holes. These bores, or tunnels, resembled small shot-holes, and ran indifferently up, down, or to either side, but were *all single*—that is to say, they never branched like the breeding-galleries (see figure, p. 9); so far as I examined, they were seldom more than about three times as long as the beetle, and at the end of these tunnels the beetles had been passing the winter, as about the middle of February beetles had been found in them, some alive although not active, and some dead; and the specimens of bark sent me on March 16th similarly contained Ash-bark Beetles, some alive, some dead, in the borings.

Hybernation appeared to begin towards the end of September, as on the 22nd of that month beetles were found *making their way into healthy bark;* also specimens were sent me in which the beetles (then *developing*), instead of having escaped as usual by a hole through the bark at the end of the borings which they had eaten out while maggots, were to be found turned in the other direction (in short borings like the winter ones) into the solid wood.

The beetles infested trees of all sizes for these winter tunnellings, and did much damage in the locality, as they worked into healthy as well as sickly trees for the purpose.

Further observations were sent me of infestation of *H. fraxini* for

* 'Europäischen Borkenkäfer,' von W. Eichhoff, pp. 138, 139.

breeding purposes; but the specimens in these instances were all taken from felled Ash timber.

On June 15th the beetles were still laying eggs in some of the galleries, but in some cases these were full of grubs, and the beetle was not found boring for *laying* purposes into the growing tree (with the exception of two or three holes which were begun and deserted), conjecturally because the flow of sap at this time of the year would be injurious to the egg and grub.

In the past season the Rev. John Martin favoured me with some notes on April 28th regarding what proved to be attack of *H. fraxini*, then in progress to some trunks of Ash trees then lying in the wood-yard at Charley Hall, Loughborough. These had been cut down twelve months previously on account of shot-like holes having been observed in them, and had remained lying in the yard ever since. Of these Mr. Martin observed:—

"They now show little heaps of saw-dust in places all over the bark like the dust caused by what is commonly called 'worm-eaten' wood in furniture. By digging with a knife in the bark under this heap of dust you find a 'shot-hole.' By following up the 'shot-hole' into the bark some three-quarters of an inch, I found two beetles usually in each hole. These seem to be at work, and evidently start from the outside, as they lie at the end of the hole, and will, I suppose, found a family there."

The supply of specimens forwarded clearly showed the infestation to be of the Common Ash-bark Beetle, not of *H. crenatus*, noticed in the following paper, regarding which as infesting some of his Ash trees I was then in communication with Mr. Martin, who amongst other observations and enquiries regarding *H. fraxini* remarked:—

"They are not in *live* trees, but in dead logs, so cannot injure them; but I don't want to perpetuate the breed in the country."

We appear to have notes now of this infestation throughout the year, showing that in winter the beetles may be found at the end of the tunnels which they bored in larval state, or sometimes in special continuations of these going a little way into the wood of the tree; sometimes also in little borings pierced from the outside into the bark.

In April, or possibly just a little later, the year's attack is begun, and burrowing of the beetles and subsequent development of the brood continues (as described) till the life-history is completed by the beetles hybernating ready for the next year's attack. With this *H. fraxini*, the development is completed in *one* year, and it appears open to supposition that there are sometimes two broods in one year, but I am not aware that the point has hitherto been entered on in this country.

As the attack takes place for the most part to felled timber, it cannot be ranked amongst our especially mischievous infestations, still the winter presence of beetles in bark of standing timber is not good in itself, and helps very much towards providing starting localities for the next year's attack to whatever Ash trunks or boughs, felled or standing, may take the fancy of the beetles.

In the notes on winter presence of the beetles forwarded from Llanelly (see p. 13), Mr. M'Intosh observed that "The beetles infest trees of all sizes for these winter tunnellings, and do much damage in the locality, as they work into healthy as well as sickly trees for this purpose; and, though they for the most part bore into the bark round the base of dead branches, or twigs, or into the young bark forming over the wounds caused by pruning, they do not confine their attacks to these places. They also often work their way into the bark by the side of dead leafless ivy" (A. M'I.).

Prevention and Remedy.—The great point is not to allow (so far as possible) presence of timber, felled or standing, which is suited for attracting attack, and if attack is found present to destroy the bark before the maggots have progressed to beetle state, as from observations taken it does not appear that attack would be likely to occur to healthy trees unless there were *felled* or unhealthy trees near which were suitable for breeding places to act as nurseries of the pest to the surrounding neighbourhood.

With regard to remedies, the removal of such felled timber and dead or dying branches as are suitable for breeding-places is obviously one desirable plan. The best time for this is, speaking generally, the month of June, but any time between completion of egg-laying and development of the beetles will answer with certainty (quite irrespectively of variable times of development). Where such attack is present, it might be worth while to strip off a small bit of infested bark in a few places to ascertain amount of advance of development in the galleries.

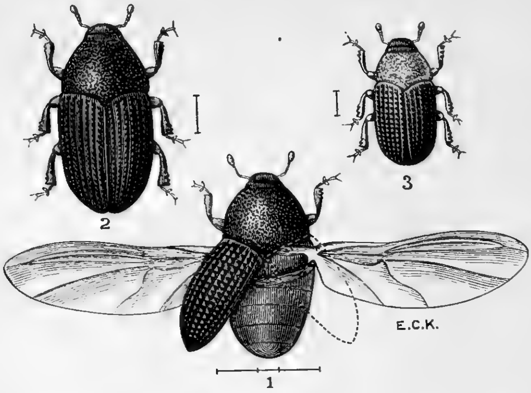
Where felled trees are known to be likely to be attacked, the application of a coat of tar would be an effective preventive, and cost little.

Where the bark of young standing Ash trees is found to have been pierced into for winter shelter of the beetles, it has been recommended that they should be gone over by trustworthy workers, and during the month of March, and guided by the shot-hole-like marks in the bark, pare off the outer bark down to the depth at which the beetles are hybernating in their tunnels. This remedy is considered to cause little injury to the trees, but is not advised earlier than March, as the Ash is liable to injury of the bark from effect of cold.

Soils which from defective drainage or from their nature (as cold and stiffish clay) are unsuitable for the Ash—by producing unhealthy trees—tend also to cause breeding-places for the Ash-bark Beetle infestation.

Also the custom, where there are large rough hedges, of "*laying*" what amount of Ash there may be in it (that is, cutting the poles half-way or more through, so that they may be *laid* lengthways to form part of the hedge) is very objectionable, and Ash thus treated is to be found in some districts much infested.

Greater Ash-bark Beetle. *Hylesinus crenatus*, Fabr.



Hylesinus crenatus.—1 and 2, beetle, with wings expanded, and one wing-case drawn only in outline, to show lower part of wing; and beetle as usually seen—magnified; 3, smaller and paler variety, magnified; also lines showing natural length.

The Greater Ash-bark Beetle, figured above, may be generally distinguished from the common kind mentioned in the foregoing paper by its larger size and darker colour, wholly free from paler mottlings on the upper side. The galleries also differ in the circumstance of this species (*H. crenatus*) having the mother galleries shorter than those of *H. fraxini*, and the larval galleries fewer in number, and much more irregular.

The species is widely distributed both in England and Scotland, but appears as a rule to be rather scarce, and to be rarely noticed, possibly from being very local in many districts, very possibly also from the differences between the beetle and its workings not being very easily distinguishable without careful examination from those of *H. fraxini*, excepting by skilled observers. But where it does occur, it sometimes is recorded as appearing in great numbers.

The only enquiries regarding the attack which I have received were sent me by the Rev. John Martin, of Charley Hall, Loughborough, with specimens accompanying, which from the thickness of the bark and amount of the very irregular tunnellings, showed that much harm was being done to Ash of considerable size, and, from the presence of *H. crenatus* beetles, showed this species to be the cause of the mischief.

The beetles are usually the fifth of an inch or rather less in length, short and broad in form, and black, rather shiny, and with few hairs. The thorax slightly broader than long, narrowed and coarsely punctured in front, less closely punctured behind. Wing-cases deeply striated, with the spaces between roughly tuberculated; legs black or dark, feet usually lighter; antennæ (horns) clubbed, and rusty or dark rusty-coloured.

These beetles, which are described by Herr Eichhoff as being the largest amongst the allied species,* are very easily known from *H. fraxini* by their much greater length, their shiny black colour, without any mottling of grey above, and also the very observable tuberculation of the wing-cases. They vary sometimes both in colour and shape (see figure, p. 16, where "1 and 2" are given as they are *usually* found, magnified, with lines showing natural length and expanse of wings; and "3," of a smaller size and redder colour, sometimes occurring); but the tuberculed wing-cases and the absence of all paler mottling on the upper surface are sure guides by which to distinguish this species from *H. fraxini*.

The method of attack is much like that of the "Common" Ash-bark Beetle; the female beetle pierces a short tunnel through the bark, and beneath it in the "cambial region" (that is, where the new wood forms yearly between the outer part of the wood and the inner part of the bark) she tunnels her galleries for egg-laying. These are generally short compared to those of *H. fraxini*, and sometimes two-armed, but these, it may be, differing from each other in length, and sometimes only one branch is present.

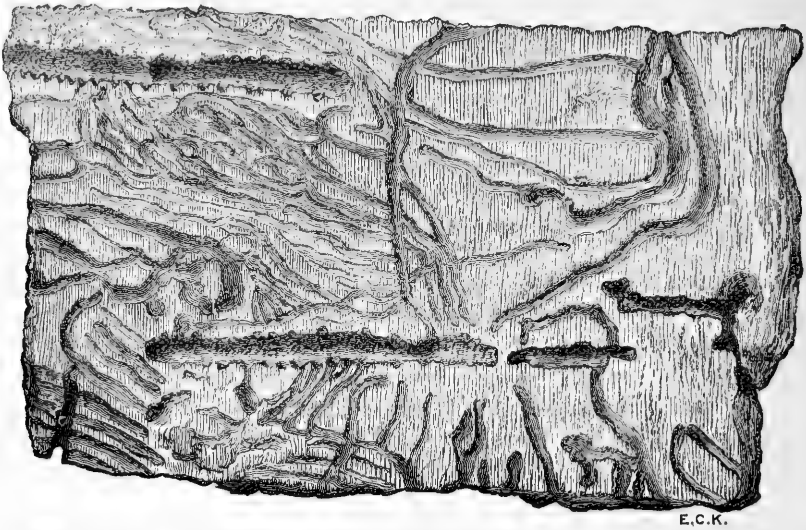
Along the sides of these galleries the white eggs are laid, often at considerable distances one from the other. The white, legless grubs on hatching out, gnaw their tunnels, at first at right angles to the mother-tunnel; but later these tunnels, which increase in size as needed to accommodate the increasing size of the grubs, wind irregularly, even so as to run parallel with the mother-gallery, and in smaller stems may be continued so far in length as almost to ring the tree.

The above points—that is, the shortness of the mother-galleries, the small numbers of little chambers for eggs along their sides, and the very irregular twisting of the maggot-tunnels—are given in the following figure, taken from some large pieces of Ash bark showing good examples of workings of *H. crenatus*, kindly given me by

* 'Die Europäischen Borkenkäfer,' von W. Eichhoff, p. 134.

Dr. J. Stewart MacDougall, Entomologist to the Highland and Agricultural Society of Scotland, together with specimens of larvæ and pupæ, and some observations, from which, with his permission, I extract the following notes :—

"On May 12th, 1898, I received some pieces of Ash stem, which, on examination, showed themselves to be infested with *H. crenatus*



Piece of Ash bark, showing mother-galleries and also larval galleries of *Hylesinus crenatus* in the inner side.

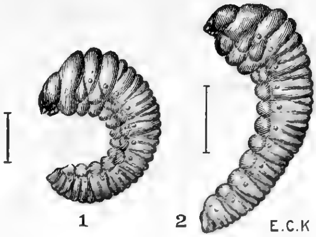
larvæ. In the first week of July imagines began to issue. On July 12th, 1898, I took a piece of thick barked Ash that had been lying cut for some time, but was still fairly fresh, as tested by cutting away a little of the bark. This piece of stem, measuring eighteen inches long by nine inches in diameter, I placed in a large cotton bag, and introduced some live newly issued *H. crenatus*.

"On examining this early in August, bore-holes and bore-dust gave promise of a successful experiment.

"Examination of the log on July 9th, 1899, revealed a flight-hole, evidently newly bored, and on dissecting away the bark I found a number of pupæ, and several large larvæ evidently about to pupate."—(J. S. MacD.)

The larvæ, of which Dr. MacDougall sent me a plentiful supply from his collections during the past summer, varied from rather over one-eighth to three-eighths of an inch in length, and were (as figured, p. 19, much magnified) cylindrical, legless; segments somewhat largest behind the head, those succeeding deeply and numerously furrowed across above; markings less noticeable below; head much smaller than the following segment, smooth, and chestnut colour in the youngest specimens, paler those apparently full-grown or nearly so; mouth-parts pitchy.

The pupæ were fully formed, with the heads bent downwards, and clubbed antennæ well developed, and the deep longitudinal striæ along the wing-cases were very observable.*



Larvæ of *Hylesinus crenatus*, magnified; lines showing natural length.

With regard to time occupied in development, it has been recorded that *H. crenatus* takes two years to undergo its transformations, the larvæ assuming the pupal state at the end of the second summer.

But of this Dr. MacDougall, in his recent observations (placed in my hands), observes:—

"The length of an individual life cycle, however, will depend on the season of the year, earlier or later, that the adults have laid their eggs, and whether or no winter will have intervened to retard development. Hybernation may take place in the adult stage, or as larvæ or pupæ, and all these stages may at other times of the year be found at the same moment. For example, on dissection of an Ash stem in the first week of March, 1898, I found larvæ and beetles in the same piece of bark; again, in May, in the same stem, flight-holes, adults and larvæ of different sizes; while from a stem kept under observation, beetles began to issue at the very beginning of July, and continued to appear during August."

Amongst the numerous specimens of long infested Ash bark sent to me by Mr. Martin, from Charley Park, near Loughborough, which I examined on May 15th, I found the *H. crenatus* beetle present. The galleries showed some variety in working. In one instance the beetle was present in a burrow just its own length, in the outside of the bark, presumably entering for breeding purposes. I also found the one-branched gallery mentioned by Dr. Chapman (in his paper referred to *ante*, p. 9) as being the most frequent form. In one case I found a flat surface of about an inch and a third in length, by rather more than a third of an inch in breadth, on the outside of, and partly biting into the young wood, and showing maggot (larval) workings, very much resembling, together with the flatly gnawed-out surface, the figure given by Prof. W. R. Fisher† at p. 247, referred to below.

* The above specimens not being now quite fresh, I am not able to give more minute details with certainty.—E. A. O.

† See Dr. Schlich's 'Manual of Forestry,' vol. iv.; 'Forest Protection,' by W. R. Fisher, B.A., Assistant Professor of Forestry, Royal Engineering College, Cooper's Hill, Late Conservator of Forests to the Government of India, pp. 247, 248.

This represents the mother-gallery leading to a surface, altogether about two inches by one, in which the larval galleries have been "so closely packed that their galleries have coalesced," and consequently all traces of these have disappeared, excepting at the external part of the working, where there is room, the galleries are visible, with the tenant at the extremity. Prof. Fisher mentions both *crenatus* beetles and larvæ being present, but notices the working as "hardly typical of the species." In my own specimens two of the galleries ended in what had apparently been the pupal cell; and (from no other attack than that of *crenatus* being observably present) I conjecture the specimen to have been an example of this unusual form of working, but am not able to give complete proof.

This attack is recorded as especially infesting Ash trees of considerable age, especially such as are in sickly condition, and also when established in one stem not to desert it willingly for another. On this habit it is mentioned by Mr. A. C. Forbes, in his excellent paper in the Highland and Agricultural Society's 'Transactions': "The beetles rarely leave a tree which they have once attacked until it is completely destroyed, each successive generation eating further and further into the least vigorous parts of the tree. In this way old Ash of large size may be destroyed in a few years; and the fact that more damage is not done by this beetle can be accounted for in some measure by the fact that Ash timber is rarely allowed to remain in plantations to a great age in large numbers."—(A. C. F.)

The species is noted by Herr Eichhoff (see work referred to in note, p. 17) as being found over almost the whole of Europe (Sweden, Russia, Germany, Austria, France), and, though usually only found as an Ash infestation, is sometimes found in Oak.

Prevention and Remedies.—The only practically available measures appear to be felling infested trees, and lopping infested branches, and so treating these that the beetles should, even if so disposed, be unable to leave them on finding their habitat unsuitable for continuance of their operations.

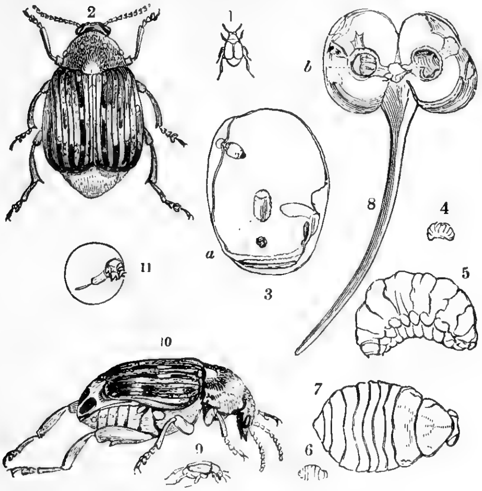
Stripping the bark and destroying it may be expected to get rid of the infestation, as any small amount which might be in the outer wood of the tree would almost surely perish from exposure. Tarring also is a good treatment, very effectual and costing little.

The treatment especially needed in the case of the Common Ash-bark Beetle—namely, removing and guarding *newly felled* Ash trunks from the attacks of *H. fraxini*—appears to be useless or exceptionally useful in the case of *crenatus*, by reason of this species infesting not felled but standing trees.

In the case of attack occurring to young trees, as appears sometimes to happen, this, of course, needs careful attention, according to the local circumstances leading to the unusual presence, but probably cutting down and getting rid of the centres of the infestation would be the safest course.

BEANS.

Bean-seed Beetle. *Bruchus rufimanus*, Bohm.
Pea-seed Beetle. *B. pisorum = pisi*, Linn.
Sad-coloured Bean-seed Beetle. *B. tristis*, Bohm.
Red-horned Bean-seed Beetle.* *B. brachialis*, Fahrs.
Red-footed Bean-seed Beetle. *B. rufipes*, Herbst.



BRUCHI.—1 and 2, *Bruchus rufimanus*, natural size and magnified; 3, infested Bean split open, showing cell; 4 and 5, larvæ, natural size and magnified; 6 and 7, pupæ, natural size and magnified; 8, Bean injured by beetle, vegetating; 9 and 10, *B. pisi*, natural size and magnified; 11, injured Pea.

The histories of the little beetles figured above, which do a good deal of harm in this country by infesting Broad Bean and also Pea seed, have long been so well known that it would scarcely be worth while to refer again to the subject but for the circumstance of three other species of *Bruchi* (also infesting Pea and Bean seed) having been found, together with our two long-established pests, during the past

* In the absence of any other available English name that I am aware of, I have ventured to suggest Red-horned, as a translation of the *ruficornis* of one of its synonyms, and appropriate to the antennæ of the male being red.—E. A. O.

season at Hull, in a cargo transmitted by steamer from Smyrna, of which Broad Beans and Peas formed a part.

As on investigation it proved that the five species now received from Smyrna were all inhabitants of localities of Syria or Western Asia, as well as of the warmer parts of Europe and various of the Mediterranean regions, it appeared so very possible that (in these days of rapid transmission) the *three* new species might (unless attention was directed to them) effect a settlement as firmly as our long-established kinds, that I have endeavoured, after procuring precise identifications of the species, to give descriptions and figures which possibly may help consignees to recognize the new comers.

It was on Aug. 1st of the past year that a memorandum was sent me from a firm at Newark-on-Trent containing the following observations and enquiry :—

"We are sending you some weevils taken from Smyrna Barley just received from Hull. They are of a different kind to those hitherto found by us in foreign Barleys, and we shall be glad if you will kindly give us some information respecting them."

On examining the specimens sent, it was plain that these broad-made, short-snouted beetles were (as my correspondents presumed) of an entirely different kind to the very observably *long*-snouted grain weevils, and I, in reply, suggested that they (the *Bruchi*) might have been transmitted in Beans or Peas. To this, four days after, my correspondents replied :—

"In confirmation of your view, we have this morning received from the shipper of the Barley in Hull a letter stating that 'the *Bruchus* must have got into our Barley from a parcel of Beans.' We are writing to ask him whether he knows there was a parcel of Beans on board."

On August 10th this point was made very clear in the following remarks from my enquirers at Newark-on-Trent :—

"Since we wrote last week to you, we have ascertained that the steamer in which our cargo of Barley was imported carried also a consignment of Beans in the same hold, bearing out the opinion you expressed."

And on the 20th (August) they further mentioned (in reply to my request for some specimens of the injured Beans) :—

"We have written our correspondent, and asked him to forward you direct three or four dozen in the infested pulse. . . . We may mention there were wild Peas in the consignment of Barley under consideration, most of which were eaten."

On September 1st I was obliged by specimens from the shippers at Hull, with the note :—"We have pleasure in sending you a few dozens of the Beans you require."

Thus we have (from an entomological point of view) a most satisfactorily complete observation,—the cargo of Barley, containing amongst it Beans and wild Peas, was forwarded from Smyrna by the rapid transmission of a steamer to Hull, and attention was drawn at Newark-on-Trent by the numbers of *Bruchi* straying about in the Barley to there being something amiss; examination showed infestation to be present in the Peas and Beans, and in the latter (of which plentiful specimens were forwarded me) I found *Bruchi* just ready to come out.

On examination of the specimens sent me I found presence of four species, of which two were of our long known kinds, namely, *Bruchus rufimanus*, Bohm.,* which infests Broad Bean seed, and *B. pisi*, L. (=*pisorum*, L.), which is found in Peas. Besides these were two species with which I was wholly unacquainted, and I was much obliged to Mr. Oliver E. Janson, F.E.S., of 44, Great Russell Street, London, W.C., for identifying them for me as, respectively, *B. brachialis*, Fahrs., and *B. tristis*, Bohm. Besides the above kinds, a single specimen of yet another species was found by Mr. Janson in the small consignment, which proved to be of *B. rufipes*, Herbst.

The figures of the first two are given at p. 21; and also of all the five species placed near together for convenience of comparison of the characteristic markings, at pp. 24, 25.

The description of the main distinctions of the beetles, also the countries where they are chiefly to be found, may be shortly given as follows.

B. rufimanus, Bohm. (Broad Bean-seed Beetle), 1 and 2, p. 21; 5, p. 24.—Length 3–4 millimetres †; shape oval; on the whole much resembling *pisorum* (description of which see following), but less densely clothed with short brown hairs. The wing-cases are variously sprinkled and marked with white and greyish or reddish hairs; and with a longitudinal black line interrupted by a few white lines near the inner edge of each. Wings ample.

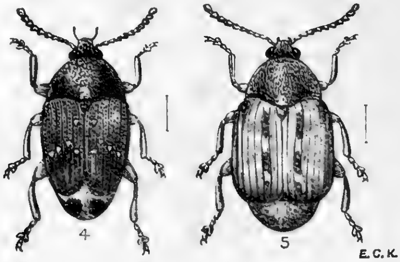
The *pygidium* (that is, the exposed terminal part of the abdomen) *clothed with grey pubescence*, occasionally, or in some lights showing two dark spots. Thighs of the foremost pair of legs and four lowest joints of the antennæ rusty or red.

The markings, or absence of marking, on the grey down of the extremity of the abdomen is one characteristic by which the five kinds of *Bruchus* under consideration may be distinguished from each other.

* The *B. granarius*, L., of Curtis and many writers.

† Twenty-five millimetres are equivalent to one inch, so also are twelve lines; consequently, for general purposes, two millimetres may be considered as nearly equivalent to one line. But for scientific purposes it may be desirable to give the length to a fraction, therefore I note the measure in millimetres as above.

The black line spotted with white running along near the inner edge of the wing-cases is very noticeable in the above-named species, *B. rufimanus*, when the specimens are fresh; but these are often so



BRUCHI.—4, *B. pisorum = pisi;* 5, *B. rufimanus*, magnified, with lines showing natural length.

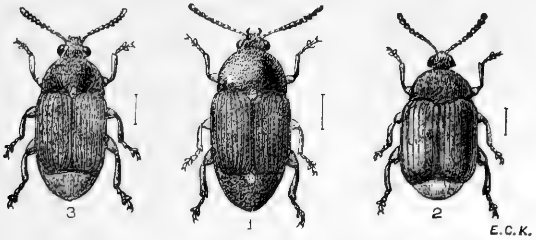
much injured that they appear almost black, from the hair being rubbed off.

This species has long been naturalized (even if not originally one of our native insects) in this country, and is to be found in Central and Southern Europe, also in Syria, Egypt, and the whole of Northern Africa. It has been noted by the late Dr. C. V. Riley that, "although this species has frequently been brought to the United States, it has probably not obtained permanent footing there."* Also, at p. 165, vol. v., of same work, it is mentioned that this species, *B. rufimanus*, Bohm., has been bred from Pea pods imported from Switzerland, and from Peas distributed by the U.S.A. Department of Agriculture in 1890. But though elsewhere, and as matter of curiosity, it may have been recorded as present in a very few of the *Leguminosæ* besides Beans, with us it is, I believe, solely troublesome as infesting Broad Bean seed.

B. pisorum, Linn. (= *pisi*, Linn.), figs. 9, 10, p. 21; fig. 4, above. Length 4–5 millimetres. One of the largest of the species under consideration; oblong ovate, black, variegated with various shades of greyish down; shanks and feet of the foremost legs, and feet of the middle pair red. Thorax transverse, narrowed in front. Scutellum (small spot at the middle of the base of the thorax) whitish, with a minute white spot before it. Wing-cases with spots or marks of white down—these sometimes arranged as a wavy band, about four in number, across each wing-case, with one spot on each nearer the base. *Pygidium thickly clothed with whitish down, showing two large bare black roundish spots.* For this, see fig. 10, p. 21, and fig. 4, above; it is a very important characteristic distinction.

* 'Insect Life,' vol. vi. No. 3, p. 220; Periodical Bulletin of the U.S.A. Department of Agriculture.

This kind is very well known with us as an infestation. It is especially found in Central and Southern Europe, Syria, and Algeria, and is recorded in the North of America by Schönherr: "Is common everywhere in Peas and Beans."



BRUCHI.—1, *B. tristis*; 2, *B. rufipes*; 3, *B. brachialis*—magnified, and lines showing natural length.

The figures of *B. rufimanus* and *B. pisorum* are repeated again at 4 and 5 (as well as at p. 21) to show the similarity of species known to be received from Smyrna with those which, whether naturalized or indigenous, have long troubled us in Britain; and also for convenient comparison with the figures above, numbered 1, 2, and 3, showing the characteristic *differences* of these newly noticed specimens received with them from Smyrna at Hull.

B. tristis, Bohm., figured above at 1, is about 4 millimetres in length, oblong ovate (narrower in shape than *rufimanus* and *pisorum*, see figures), and especially distinguishable by its almost *bare and shining black upper surface*, with a small but conspicuous *white spot* at the base of the thorax, and another of a somewhat long shape on the middle of the base of the pygidium. Thorax finely punctate; wing-cases striated with the interstices finely rugose. Antennæ with the lower part red, the rest dark. Tarsi and tibiæ (feet and shanks) of two pairs of fore legs pale; pair of hind legs black.

Localities.—Central and Southern Europe; little found in higher Italy; more frequently in Central and Southern Sicily. Also has been found in Syria; has been reported from Central Persia, and found in Liguria in Pea seed.*

B. brachialis, Fahrs. (male *ruficornis*, All.), see fig. 3, above,

* For full description, together with localities of *B. tristis*, from which the above abstract is taken, see "*Mylabridum* seu *Bruchidum* europeæ et finitimarum regionum *Faunæ* recensitio," Flaminio Baudi (Deutsche Ent. Zeit. xxx. 1886, Heft ii. p. 397). In the above-named monograph, Signor Baudi adopts the generic name of *Mylabris* instead of that of *Bruchus*: but the latter name has now been generally adopted for such a great length of time that it seems undesirable to revert to that of *Mylabris*, which has now been long used for the group of Blister Beetles. E. A. O.

About 3 millimetres in length, shortly oval, black, mottled with dusky down and whitish spots above; this especially on the middle basal lobe of the thorax, on the wing-cases somewhat irregularly sprinkled. *Pygidium with whitish down.* Horns (antennæ) in the male red; in the female dark, with the four or five basal joints, and likewise the terminal or sometimes the two terminal joints of some shade of red. Both sexes with the anterior legs only red.*

The localities of this species are recorded as being Central and Southern Europe and Algeria; and of a variety it is noticed that it is rare in the mountains of Southern Europe. Also it is noticed of *B. pallidicornis*, Bohm., by which name this species is often known, that it is frequently found in Syria, especially in Lentils.†

B. rufipes, Herbst. (fig. 2, p. 25). Ovate, rather shiny, slightly pubescent, the wing-cases ornamented with whitish grey or tawny spots or little patches; similar to *B. brachialis* in length (3 millimetres), but sometimes a little larger, and when seen from above somewhat subquadrate in shape. Basal lobe of the thorax and the scutellum with grey pubescence; pygidium also with grey pubescence.

Antennæ in both sexes have *the basal joints alone red*, and the *foremost and the second pairs of legs reddish*, whereby this species is distinguished from *B. brachialis*, as well as by its squarer shape, which is conveyed at fig. 2, p. 25.

Localities.—Europe, also Tiflis in Syria. Very common in Italy in vetches; "especially mixed with Wheat in fields or granaries" (F. B.).

It cannot be said that this species (*B. rufipes*) is wholly unknown in this country, as the following observation is appended by Canon Fowler ‡ to his description of this species:—"On *Leguminosæ*, very rare; three specimens taken by Dr. Power at Surbiton and Gravesend in June, 1869, are all, apparently, that have occurred in Britain."

Amongst the vast number of species of *Bruchi* distributed in various parts of the world, amounting to four hundred or more, it is impossible to say how far the details of structure of the larvæ (maggots) and the precise methods of infestation may be similar in all cases; but, as regards ourselves, that of our British Bean and Pea-seed Beetles appear to be

* By the above-mentioned colouring of the legs and horns this species may be distinguished from *B. rufipes* (of which a description is given below), which otherwise it much resembles. It is exceedingly difficult to convey the differences in a moderate sized figure, but at 3, p. 25, it has been endeavoured to convey the pale colour of the terminal antennal joint of the male, and also the whitish coloured downy spot at the base of the thorax.

† The descriptions of the two above-mentioned species, *B. tristis* and *B. brachialis*, and also of *B. rufipes*, given below, are abridged from those given in the 'Monograph of *Mylabridæ* seu *Bruchidæ*,' by Flaminio Baudi, referred to in note, p. 25, preceding, together with careful comparison of my own verified type specimens.

‡ 'Coleoptera of the British Islands,' vol. iv. p. 263, 1890.

very similar,* and the following short notes of method of attack of the Bean-seed Beetle, *B. rufimanus*, though well known, may save trouble in reference.

The method of attack is for the beetle (which is furnished with ample wings) to fly to the blossoming Beans, and to lay its eggs on the young seed-vessel in the centre of the flower whilst it is still so small that it can hardly be called a pod. From these eggs the little maggots soon hatch and make their way into the growing seed in the young pods. Each maggot gnaws a gallery into the seed, and possibly there may be more than one tunnel; but in its tunnel each maggot (in the dirt and rubbish consequent on its feeding during its own growth up to maturity in the growing Broad Bean) turns to chrysalis, and from this to the beetle state (see figs. 3–7, p. 21). But before it changes from the active maggot condition to that of the quiet chrysalis, it (customarily) gnaws its gallery right *up to* the skin of the Bean, but *not through it*, so that the circular bit of skin remains at the end of the burrow undetached, but just sinking in a little from the substance of the Bean having been removed behind it; and when the tenant has passed to beetle state, and it is time for it to go forth from the full-grown ripened seed and fly abroad, it has only to press out the door, so to call it, of its burrow, and become free.

The maggots are fleshy, wrinkled across, and with a small horny, rusty-coloured head, and so far as I am aware, in the case of this kind, always legless.

With the larvæ of the Pea-seed Weevil, *B. pisorum*, L., the case is somewhat different, in respect of it possessing three pairs of "false legs" on the fore part of the body in its quite early life—that is, one pair on each of the three segments next to the head; and also, if circumstances should not suit the maggot for boring into the Pea *seed* immediately on hatching, that it sometimes lives as a miner for a while in the inside of the pod.

A description of these six "post-embryonic" legs, with much magnified figure showing them in the case of the larva of *B. fabæ*, Riley, which may be taken as showing this peculiar structure *also in the case of the larvæ of B. pisorum*, will be found in 'Insect Life."† And at p. 392 of the same work will be found mentioned that the newly-hatched larvæ of *B. pisi* (= *pisorum*) have almost the same characteristics as those described in this case (see reference in note), that is, of the Bean-seed Beetle of America,‡ excepting that the three pairs of legs of the Pea-seed grubs are somewhat shorter and stouter. In both cases the small

* A slight difference in structure of the larva of *B. pisorum* in its early condition has been found to exist. (See above.)

† See 'Insect Life,' vol. iv. pp. 300, 301.

‡ *B. fabæ*, Riley, now known as *B. obtectus*, Say.

representations of legs are stated to be moulted as soon as the grub enters the seed.

The point of the larva sometimes living as a miner in the Pea *pod*, unless the seed is nearly grown, is of very considerable interest; and so is that of the point of entrance of the newly-hatched maggot into the Pea seed (although it soon heals over) leaving a speck on the side of the seed as a mark of the entrance.

All who have carefully examined our own infested Broad Beans can hardly have failed to notice little dark specks, and, though I am not aware of the above-named reason for these dark dots on the Broad Beans having been given from observation, I have conjectured that they, as well as the round depressed bit of skin at the end of the tunnels, might be taken as a sign of infestation.

It is somewhat curious, and a matter perhaps worth attention, that, although *B. fabæ*, Riley,—at one time known as *B. obsoletus*, Say, and now as *B. obtectus*, Say,—is so well-known as the Broad Bean-seed Beetle of America, and also is injurious in South Africa, we do not appear to be troubled with it here.

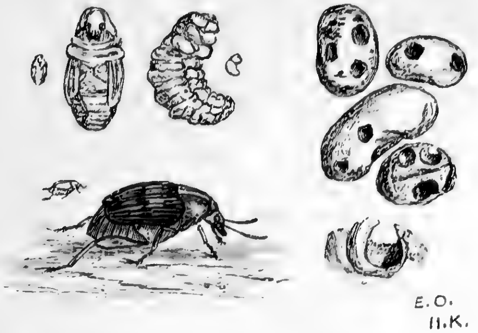
This beetle is from about a tenth to a sixth of an inch in length, slightly shining, blackish, with fine ashy or ashy brown down. Thorax much narrowed before, with a slight impressed dorsal line, and (in my South African specimens) the pubescence is closer, and forms a pale longitudinal line in the centre. The scutellum nearly square, lightish, longitudinally divided by a dusky line. Wing-cases finely and closely punctured, with ten impressed rows of larger punctures on each—the lines between the interstices having a slight appearance of alternating whitish and dusky—and three indistinct transverse marks (see figure, p. 29) produced by a paucity or absence of the pubescence. Sides and apex of the abdomen and pygidium dull red. The legs entirely dull red, with the exception of the posterior thighs, which are black on the under side, and have a small acute tooth near the apex.

The above description is taken in part from that of Say, but chiefly from that of Mr. O. E. Janson* of my own specimens, forwarded, together with maggots and infested Beans, from Port Elizabeth, South Africa. At that time we were not able to identify the species of *Bruchus* with certainty, and I therefore merely noted it as *much resembling B. subarmatus*, Gyll. Subsequently, however, in the course of much correspondence between the late Dr. J. A. Lintner, Mr. Janson, and myself, it appeared from type specimens submitted for comparison with our South African *Bruchi* to Mr. Janson, that these were without doubt of *B. fabæ*, Riley, now known as *B. obtectus*, Say.†

* See 'Notes and Descriptions of a Few Injurious Farm and Fruit Insects of South Africa,' by Eleanor A. Ormerod, with descriptions and identifications by Oliver E. Janson, F.E.S., pp. 23, 24; 1889.

† See 'Insect Life,' vol. vii. No. 5, p. 419; Washington, 1895.

The infested Beans, and also the maggots, forwarded from Port Elizabeth showed (respectively) a slight difference in method of infestation and in structure from what is usually recorded. In some instances I found that the maggot-tunnels, instead of stopping just under the skin when they came to the outside of the Bean, ran on just



BRUCHUS OBTECTUS.—Beetle, maggot, and chrysalis—all natural size and magnified; and fragment of case of chrysalis, magnified; and four injured Beans.

underneath it, so that the shape and the blackish colour of the insects when developed to beetle state could be seen through the thin transparent coat of the Bean.

Also, in some instances, it appeared from the gnawings that the maggots had made, or might have made, their entrance into the seed *from the outside.*

On microscopic examination I found that the maggot, as usual with other species of *Bruchi*, was corrugated, but also that the three segments next to the head were distinctly divided beneath from each other, and that each of these segments was furnished with a pair of appendages placed in the common position of feet, and, as far as I could see, answering the ordinary purposes of claw-feet.

I was informed by the late Mr. S. D. Bairstow (President of the East Province Nat. Hist. Soc. of Cape Colony), that the kind of Bean which these beetles* most attack was the "Sugar Bean," but that many kinds of Beans were also attacked by them, and, judging both by the descriptions and specimens forwarded, the attack was peculiarly injurious.

In two of the South African Beans (figured above) I found *four* holes, showing where *Bruchi* had escaped; in another, seven beetles

* The terms of "weevil," as well as that of "beetle," are sometimes used indifferently for these *Bruchi*, and scientifically the term weevil is certainly preferable; but in this paper I have used the word "beetle" throughout to avoid any chance of confusion with the Bean and Pea-*leaf* Weevils, *Sitones*, which are a most prevalent pest in this country, and to which the name of "weevils" is, I believe, always given with us.

had been present; and in another, I found *five* beetles, or coloured chrysalids, still within. Mr. Bairstow reported that "the pest when in larval condition reduces the interior of the seed to a fine powder, and passes into pupa sometimes in its powdery bed, which disappears almost immediately on the emergence of the perfect insect." *

The above point (of the large number of the beetles, *B. obtectus*, which may be found, even to the number of twenty-eight, feeding in one Bean seed) will be found in the paper on "Pea and Bean Weevils," for reference to which see note †; as also a second point, and one of very great economic importance, that the insects will continue breeding indefinitely in stored Beans. "If any means of exit is not present, the females will soon begin to lay their eggs upon the stored and damaged Beans, and another generation will soon develop. This may go on indefinitely, or until the food-supply is exhausted. The Bean Weevil continues to multiply in the stored Beans. These, when infested, are usually reduced at last to nothing but powder, and have no value as seed."

It has long been noticed that, although insect infestations from this country only too frequently make themselves at home in America, the reverse rarely occurs. In the years that have elapsed since careful observation has been made of Bean-seed *Bruchi* of different species on the two sides of the Atlantic, as well as in South Africa, it would appear almost impossible that, if this species (*B. obtectus*) exists here, it should not have been noticed; but, still looking at its very destructive powers, it may not be amiss to draw attention to the possibility of it occurring amongst us.

Prevention and Remedies.—The first (and a very important) measure of prevention is examination of Bean seed before purchase or sowing. If the seed *has been* infested (which is shown by the holes), the farmer sows a damaged article which will not yield him a full return ‡; if he sows Beans with a few little pits of transparent skin about as big as would cover a common shot-hole, he at the same time (unless he has had the trouble and and expense of killing the pest in the seed) *sows a coming crop of Bean-seed Beetles!* If the buyer has a doubt as to the state of the seeds, just splitting some open with his

* See 'Some Injurious Insects of South Africa,' p. 24, referred to, *ante* note, p. 28.

† See 'Insect Life,' vol. iv. Nos. "9 and 10," pp. 299–302.

‡ For observations of amount of injury to germination by infestation of *B. obtectus*, see experiments by Prof. E. A. Popenoe, of Kansas Experiment Station, quoted in 'Insect Life,' Nos. 9 and 10, vol. iv. p. 302; U.S A. Department of Agriculture, 1892. For results of experiment as to germination of infested seeds of our British kind, *B. rufimanus*, see experiments by the Rev. Theodore Wood, Ent. Mo. Mag. xxii. 1885, p. 114; also quotations from the above, showing the great amount of damage caused, in my Annual Report for 1895, pp. 10, 11.

knife will show him exactly what their state is. Autumn-sown Beans are much more likely to contain infestation than the spring-sown, as many of the beetles will still be within. And it should be borne in mind that, even *if* the infested Beans *do* germinate and grow properly, still it is highly undesirable to lay the foundation of a new brood of beetles by, as it were, sowing the parents in the Bean seed.

In the year 1888 Mr. E. A. Fitch reported to me, from Maldon, Essex, regarding direct loss of weight, and consequently of money return, in the case of Beans infested by our common Bean-seed Beetle:—

"In my own case a most moderate computation of loss of weight alone of 2*s.* per quarter, would give £65 12*s.*, *i.e.* 164 acres × 4 quarters the acre × 2*s.* per quarter. . . . I have myself delivered Winter Beans in other years weighing 19 stone 4 lb. (67½ lb. per bushel); and I hear from the corn merchants that nothing over 18 stone can be expected this year; a year in which condition, and consequently weight, is exceptionally heavy, the loss being entirely due to the ravages of the *Bruchus*."—(E. A. F.)

A safe and easily practicable method of dressing infested Beans so as to kill the contained infestation is that (recommended by Mr. Geo. Street, of Maulden, Ampthill, in 1888) of application of blue vitriol and McDougall's Sewage Carbolic. On May 10th in that year Mr. Street wrote me (with regard to whether the Beans would be injured thereby) that they had made wonderful progress, and the result, so far as he could see, was perfectly satisfactory:—

"The dressing applied to the Beans was used in a similar way to that used for seed-wheat. Formerly we used blue vitriol only, but the addition of McDougall's Sewage Carbolic leaves a smell, which to some extent prevents birds eating the seed-corn. I am inclined to think the carbolic alone would be sufficient, if a larger quantity was used. We used 6 bushels of Beans, 6 quarts of water, 1 lb. of blue vitriol, and a pint of Sewage Carbolic. I am inclined to think that Beans should be dressed some few days before they are sown (as the skin is thick), and turned over with a shovel every day. Those which escaped the liquid dressing might be killed by the strong dust which would be formed when the Beans were again dry."

Another correspondent in the same year mentioned that he had "dressed all the seed with Calvert's Sewage Carbolic Acid, of such strength as to kill all the insects in the Beans without damaging the seed."—(See 'Twelfth Report on Injurious Insects,' by Editor, p. 23.)

Besides the above remedial methods—which are very easy of application—references to various other methods of treatment—as simply soaking in water, fumigating with bisulphide of carbon, &c.—will be found in my Annual Report for 1895, which it is not necessary to repeat again here.

Stem Eelworm. *Tylenchus devastatrix*, Kuhn.

Field Bean plant infested by *Tylenchus devastatrix;* natural length, including curve of stem, about 10 in.

So far back as the year 1886 notes were sent me of a deformed and stunted growth of Field Bean plants, which probably was attributable to "Stem Eelworm" presence; but no scientific investigation was made of this pest being certainly the cause of the mischief until 1890, when, from specimens forwarded to me at request of Mr. J. R. Eve, from the Tingrith Manor Farm, near Woburn, Bedfordshire, I found that the very peculiarly deformed growth of the plants was owing to infestation of the Stem Eelworm (*Tylenchus devastatrix*), and gave a detailed account of the attack, with figures, in my Annual Report for that year.

Since that date no further observations of the attack, or at least none of any importance, have been sent to me until the past season, when I received a consignment of sixteen plants of Winter Beans from Mr. Frank Osborn, of the Manor Farm, Barton, Ampthill, with inquiries as to the cause of their diseased state.

The bundle of Bean plants was sent me on June 9th, and, of the sixteen forwarded, eleven showed the whole length of the plant upwards from ground level, and were now in full flower; but, taking length from the ground to the top (without allowing for the stem being sometimes distorted, or with one or two bends), the plants only averaged from about *eight to twelve inches in height.*

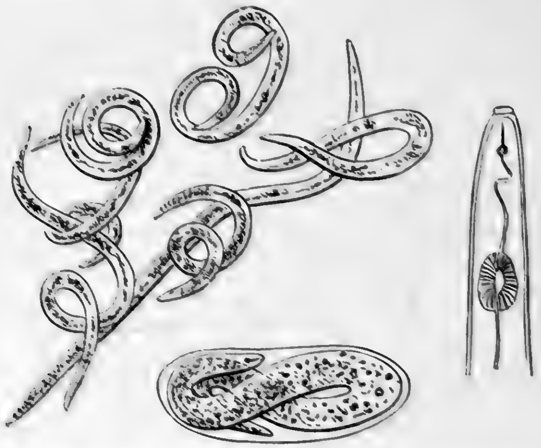
The plants were irregularly branched, forked, or distorted. In one instance a plant was bent so that at about eight inches from the ground it grew horizontally for about two inches, and then grew downwards almost straightly for about three and a half inches, with a good display of flowers. Sometimes the plants were of two branches, the central shoot between which had perished, and the lower part of the stems for about a couple of inches above ground was discoloured with various shades of brown down almost to black; the leaves on this part being stunted, black, and dead. In one case among the specimens sent there was a withered thin shoot about three and a half inches long, with a bushy top; in another, the dwarfed stem was zigzagged for part of its length with unhealthy developments of leaf-buds, or flower, on the projecting parts.

The stunted and deformed state of the plants was very observable, and in most of the cases in which I split the stems up from the ground I found them hollow for a good many inches of their length, and covered on the inside with the brownish mealy kind of coating which is a frequent accompaniment of presence of attack of *T. devastatrix*, commonly known as Stem Eelworm, in cases of Tulip-root in Oat plants, and Stem-sickness in Clover, and which was noticeable in the stems of Eelworm-infested Beans sent me in 1890.

Where attack has been long established, and the stems are much hollowed, and much coated with the yellowish or brown powder, it is very possible that there may not be any, or at least very little, Eelworm presence found in it, for the minute eel-like worms have a power of wriggling themselves from a locality which has ceased to suit them;

and in the present case I found scarcely any Eelworms in the powder, but on examining higher up, where the stem was as yet little discoloured, and little if at all hollowed, I found the infestation markedly present.

Here I found the Eelworms in a state of great activity, and in extraordinary numbers, more numerously indeed than I remember ever before seeing them together, and of all ages, from specimens



Stem Eelworm (*Tylenchus devastatrix*); anterior portion of female showing mouth-spear; and embryo in egg: all greatly magnified (anterior portion magnified 440 times). From figures by Dr. J. Ritzema Bos.

apparently recently hatched and quite transparent, up to others which appeared to be at about their full growth and showing their internal structure. Besides these there were great numbers of eggs in different stages of development.

These Stem Eelworms (*T. devastatrix,* scientifically) are very minute transparent white Threadworms, scarcely more than one-twenty-fifth of an inch in length at full growth, and only about one-thirtieth part of their length at their greatest breadth. In shape they are very like little eels (whence their common name). They multiply by laying eggs, and are to be found in egg, and larval, and also in male and female condition together in the infested plants. Other kinds of Eelworms may be present; but with good microscopic power *T. devastatrix* may to some degree be distinguished by having (like others of the *Tylenchi*) a somewhat needle-shaped process, known as the spear, placed on a *three-lobed* bulbous base in the œsophagus, or gullet (see above figure). The species cannot, however, be thoroughly identified without examination of the male Eelworm for the presence of a *bursa*, or purse, near the tail extremity.

It is almost impossible for anyone but a skilled specialist to determine trustworthily the *species* of Eelworms which may be present; therefore, on the first observations of this kind of attack to Beans being sent to me in 1890, I forwarded specimens to the well-known nematologist, Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory at Amsterdam, who was good enough to examine the specimens for me, and found amongst them the male, which, as mentioned above, possesses a *bursa*.

Therefore, as Dr. Ritzema Bos wrote, "the Eelworm which infests the Beans is a *Tylenchus*"; and further: "The dimensions of the various parts of the body, the relations between the length and the breadth, and the absolute length of the Eelworms, are such that I have no doubt at all *that the Eelworm which infests the Beans is* (*just as you supposed*) *Tylenchus devastatrix*" (J. R. B.).

The plants from which these specimens were taken were, like those forwarded to me in the past season, much stunted and deformed in growth, even down to being, in one instance, only four inches high, the stem being flattened and widened and swelled at the base. Another specimen had eight side shoots from six inches length of main stem, these being so placed that the whole plant with its shoots and pods had a kind of oval fan-shape. Some of the pods were straight and rightly shaped, but a large proportion of them were stunted and distorted, and some of them were scarcely as much as three-quarters of an inch in length. A fairly healthy plant which was sent accompanying served as a kind of scale of measurement of the damage to the infested samples. In this case the stem was over three feet and a half in length, thus showing a stunted growth of about two and a half feet or more caused by Eelworm infestation.

The condition of the Bean plants distorted and stunted by this infestation is something quite unmistakable, and for *all practical purposes* (as with Tulip-root in Oat plants, and Stem-sickness in Clover) the characteristic altered growth, joined to the condition of the inside of the stem, and the number of Eelworms which may be seen with even an inch power of magnifier is sufficient for determination of the nature of the attack. It is of useful interest to notice how often a widened and also shortened stem growth, with undiminished number of buds developed along it, show presence of Eelworm attack.

Prevention and Remedies.—No special treatment with regard to prevention of Eelworm presence in Bean plants has been brought forward either in the past season or in 1890, when we had the first definite observations of this crop being subject to attack. But from all we have long known of the habits of this *T. devastatrix*, it is presumable that the same methods of prevention or of remedy (if applied early in the attack) would be serviceable which we find answer in regard to other crops.

One important point of prevention turns on the circumstance that many of the Eelworms leave the plant in which they have fed when it dries, or otherwise becomes unsuitable to them, and then live in the surface of the land. Therefore it is very important that one kind of crop subject to Eelworm attack should not follow a crop that has been noticeably infested. Oats, Clover, Beans, and Onions are all liable to attack, the two first very observably so, therefore care should be taken that these do not follow in rotation where previous attack has been observed.

As a mechanical measure, ploughing with a skim-coulter, so as to turn the surface thoroughly under, and leave it there, is a good remedy; but common ploughing, or such digging as only breaks up the surface and scatters it, *is of little service.* "Trenching" is a perfect remedy, but there is the practical disadvantage to be considered of the cultivated and manured uppermost spade-depth ("spit") of soil being buried down out of reach of roots of common crops, and the lower spit of comparatively *un*productive soil brought to the top.

Eelworms are easily carried in earth from infested land. They may thus be transferred to uninfested land in soil adhering to the wheels of carts or barrows, or to farm and garden implements, or on the boots of the labourers or feet of horses.

Infested fodder or litter is a common vehicle of transmission. Where this material is carried to the fold or stable with the Eelworms still in it, the wormlets are perfectly likely to live on, and be carried out again to the fields in manure made from the litter, whether they have or have not survived processes of digestion in the eaten infested food.

It is desirable to collect and burn stubble of infested crops in order to destroy any of the wormlets or of their eggs which have remained within.

Special applications, which have been found most serviceable for Clover and Oats, whether as preventives, as manure in the preparation of the land, or as dressings to bring a crop over attack, and which there is no reason to doubt would be equally serviceable for Beans, are sulphate of potash alone, or as a mixture with sulphate of ammonia, or both of these with phosphates.

Sulphate of potash at the rate of 1 cwt. per acre has had a good effect in *stopping the disease* and bringing a good crop;—also at the rate of about ½ cwt. per acre it has done well.

As a manurial application, a mixture of about two parts sulphate of potash, three parts sulphate of ammonia, and four parts of phosphates, brought remarkably healthy plants, with few exceptions.

A recipe found to answer well in case of attack in "Tulip-rooted Oats" or "Stem-sick Clover" is—sulphate of ammonia four parts, sulphate of potash one part, and steamed bones two parts; this at the rate of $1\frac{1}{2}$ cwt. per acre, followed up by a dressing of 2 cwt. per acre of sulphate of ammonia.

The following note of experiment in treatment of Clover-sickness at Rothamsted, which I was kindly permitted to use, showed entirely satisfactory results:—"A mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, was applied on April 3rd." The disease ceased, and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron at the rate of 2 cwt. also answered very well both for stopping the disease and giving good growth; at the rate of 1 cwt. the sulphate of iron was not so serviceable.

All measures, whether of treatment of the ground or of liberal and rich manuring, of a nature suited to drive on hearty growth are of use in supporting infested plants if of material suited to their special nature, but *nitrate of soda* (so far as reports to myself go) has proved nearly or wholly valueless as an antidote to Eelworm sickness.*

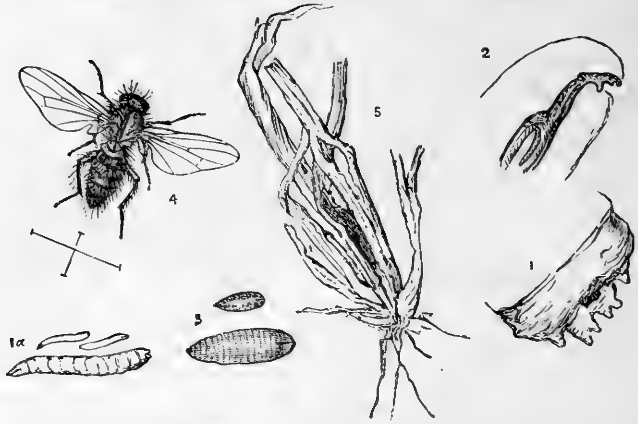
The following notes as to *entire absence of any good effect* from use of gas-lime as a preventive of Eelworm attack was sent me on March 20th from Peaston Bank, Pencaitland, East Lothian, N.B., by Mr. R. Gibson, and, as it is of considerable interest, I insert it *in extenso* here under the head of Eelworm, adding reference to it also under the head of Tulip-root in Oats. Mr. Gibson observed:—

"Referring to our correspondence in May, 1897, about Tulip-root in Oats, I promised to let you know my experience of applying gas-lime as a remedy. The field was in Oats last year (1899) after two years' old grass. In the month of February I applied about two and a half tons per imperial acre of gas-lime fresh from the works. I sowed in good order with part Potato Oats and part Hamilton Oats. The result was not satisfactory; the Tulip-root was there in both varieties of Oats. I left two riggs of ground with no application of gas-lime, and you could not tell the limed land from the unlimed; the disease was over all the field, and from this experiment I am drawn to the conclusion that gas-lime is not a cure for Tulip-root in Oats."—(R. G.)

* The above notes of prevention and remedy are to some degree reprinted from various of my previous publications. As these are known to answer well, and the descriptions are condensed into as short compass as can well be managed for practical use, it has seemed desirable to repeat them somewhat as they stand, rather than merely refer to the previous notices.—E. A. O.

CORN.

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



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

The maggot of the Wheat-bulb Fly (figured above) sometimes does a good deal of mischief by feeding in the stem of the young Wheat plant, but it is not an attack that often occurs. How long the infestation may have been present in this country does not appear to be certainly known, but it was first *certainly* identified in the year 1882. Since then it has been reported as a young Wheat pest in 1886; also in the years from 1888 to 1892 inclusive; and in 1894, in just sufficient amount for its presence to be mentioned; but since then until the past season, when it caused a noticeable amount of mischief in one English and two Scottish localities, it has not been observed (or at least not reported) in sufficient amount to be worth remark.

The two-winged flies, as seen natural size, are much like the very common and well-known "Onion Flies" in general appearance. Seen magnified, the males have the body between the wings grey, with the sides lighter and the back indistinctly striped; the abdomen hairy, oblong, narrow, flat, and ashy-coloured, with an indistinct narrow stripe along the back; end segments grey; wings with narrow veins; legs black with pale shanks. The females differ in having both the body between the wings and the abdomen pale ash-grey and immaculate, and the four hinder thighs, as well as the shanks, pale.

The maggots are about a quarter inch long, whitish, legless, cylindrical, and somewhat lessened towards the front end, which is furnished with two black mouth-hooks (see fig. 2, p. 38), wherewith they tear the substance of the plants on which they feed. So far as the above may easily be seen; but both in their appearance and in their method of attack they so very much resemble the maggots of the "Frit Fly" (*Oscinis frit*), which feeds in the heart of young Oat plants, that for sure identification (beyond the fact of one being found in Oats and the other in Wheat) a fairly strong magnifier is needed.

With this it will be seen that (in the case of the Wheat-bulb Maggot) the tail segment projects at the lowest part, and ends in two squarish-ended teeth with *flattened* edges, placed centrally, with one pointed tooth, and sometimes more, placed outside the central square pair. When seen with a high power, the ends of the central teeth are noticeably notched; and by these characteristics, and by there *not* being a little bunch of stalked spiracles near the head end, it appears to me that the Wheat-bulb Maggot may be clearly distinguished from that of the Frit Fly.

Damage, as shown by the failing and sickly appearance of the crop, may be seen early in the spring, and about the beginning of April the maggots are sufficiently advanced in size to be noticeable in the young Wheat within which they are feeding. By the beginning of May full-grown maggots may be found upwards of a quarter of an inch long, a single maggot lying lengthwise in each infested stem, and filling it up nearly to the outside.

During May the maggots cease feeding, and go into the ground, where they turn to small brown oval chrysalids (see fig. 3, p. 38), from which the little two-winged grey flies may come out any time between the end of May and the beginning of July.

The only year in which attack was reported to me as very severe was in 1888, in which packets of infested plants were forwarded to me for examination almost every day from about the first week until the end of May. The amount of injury was mentioned by various correspondents as sometimes every plant being destroyed for yards together, or a complete failure in various places, and in the Fens "hundreds of acres being eaten off"; also that near Warrington, "for several miles around, both in Cheshire and Lancashire, the Wheat crops in some fields have been greatly damaged, in some entirely destroyed." *

It is a very remarkable circumstance in the history of this attack that it has been especially found to follow on fallow, or also where, in some cases, the preceding crop had partially failed, or been so treated as to expose bare soil.

As this point is very important in considerations of preventive treatment, and it is now a good many years since the attack has been

* For observations of attack contributed by numerous correspondents, see my Annual Report for 1888, pp. 82–88.

brought under notice, I give the following short notes contributed by various correspondents.

In 1881, Mr. B. Brown, of Deard's End, near Stevenage, wrote regarding a maggot infestation which appeared to be similar to that under consideration, that it attacked some portion of his Wheat there, sown after dead fallow, and its ravages were so great that he discontinued planting Wheat after fallow. The Wheat looked well until after *Christmas*, but began to die off in the spring months. In 1882 Mr. W. Creese, writing from Teddington, near Tewkesbury, regarding this attack (of which specimens had then been trustworthily identified), observed that it attacked plants on land that had been fallowed in the previous summer, but did not appear on land ploughed for the first time in the autumn; also that it leaves a belt of four or five yards near the *edge* untouched. And in a report given me by Mr. Parlour, of Middle Farm, Dalton-on-Tees, near Darlington, in 1888, he mentioned, "I have examined several fields in the district, and find that *almost all fallow fields have suffered more or less.* In no case, so far as I can find out, has any Wheat been attacked where the land was cropped last summer."

The special reports of 1888 and 1889 mention the attack as being 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.

The only precise report of loss in an infested crop consequently on presence of the Wheat-bulb Maggot which I am aware of having been circulated, was sent me by Mr. Michael Ellison, of Barber Woodhouse, on Dec. 27th, 1889, and I re-insert it, as drawing attention with exactness to the great amount of loss in the Wheat crop that these small maggots are able to cause. Mr. Ellison, after some remarks on our previous correspondence regarding *H. coarctata*, observed:—

"It may interest you to know the result of the cropping and yield which I have just lately learned from the tenant. From one field of eight and a half acres there was no 'first' corn; only three loads or nine bushels per acre of 'seconds.' The other field of twelve acres yielded sixteen sacks of four bushels each of 'firsts,' and of 'seconds' same as above, three loads per acre."—(M. E.)

In the following notes of observation of attack in three localities during the past season, it will be noticed that one is mentioned as being after fallow, and one after Potatoes.

The first report of presence of the maggot in 1900 was sent me by favour of the editor of 'The North British Agriculturist' on May 2nd, and appeared in that journal, with my reply, on May 9th. The inquirer communicated under the signature of "Forfarshire"; but I was informed that the attacked land was at some distance from that subsequently mentioned (see p. 42) by Mr. Alex. Prain, writing from the neighbourhood of Dundee.

The contributor mentioned that he was sending a few plants of Wheat which contained either a small maggot, or traces of where it had been in the centre of the stem, and further observed:—

"I have a field seriously damaged, and another which had to be ploughed up entirely destroyed, by this insect. Both fields were sown in the autumn after Potatoes, the land being worked in a seven rotation, namely, Barley, Grass (two years), Oats, Potatoes, Wheat, Turnips. The season was most favourable for putting in the seed, the land being ploughed and pressed; the latter, although not necessary, as the land is of a hard nature on red sandstone, was done with the idea that it might prevent the ravages of the worm.

"The seed was steeped with 'Down's Farmer's Friend,' and the braid looked exceedingly well up to the middle of January. It then appeared to give way, and ten days ago scarcely a plant could be seen in the field. Every year a field, or part, is destroyed in the same way on this farm."

On careful examination of the specimens forwarded, I found, both from the condition of the young plants which had been attacked, and also by the appearance of the maggots which were still to be found, that the infestation was that of *H. coarctata*, popularly known as the "Wheat-bulb Fly."

A few days later—that is, May 4th—I received another application under the signature of W. W., by favour of the editor of 'Farm, Field, and Fireside,' with the following observation:—

"I herewith send you some plants of Wheat with a kind of white maggot in the middle of the stems near the roots; also a few in small box which I have taken from Wheat plants. These pests are doing very great damage. I shall feel greatly obliged if you will tell me: (1) what they are; (2) how they are generated; (3) how to prevent them; (4) how to stop or check their ravages."—(W. W.)

The specimens sent proved (similarly to those above noticed) to be larvæ (maggots) of the Wheat-bulb Fly, and, together with the descriptions, showed bad presence of this attack. The specimen plants were about seventeen in number, and about half of these, measuring about five inches in length, showed the fat hearty maggots, for the most part about a quarter of an inch long, lying within the stem at the base. The remainder of the plants, with hardly any exception, showed signs of the maggots having been feeding within them, of which a few had escaped into the box.

The following note of attack of what proved on investigation (like those before mentioned) to be of the Wheat-bulb Maggot (larva of

H. coarctata), was sent me on May 19th by Mr. Alex. M. Prain, from Rawes Farm, Longforgan, by Dundee, N.B.:—

"I enclose a few plants of wheat which were sown in autumn *after fallow* on fairly heavy clay land. . . . The Wheat came away very strong in the autumn, and looked vigorous up till the early spring. It then showed signs of getting thinner on the ground, and also looked sickly. This I attributed to the very severe spring weather we had. It is now so thin that I am debating whether I may not have to plough it up. On examining some plants the other day, I found, just about the root of the stalk, a small white worm, and it looks to me as if this was the secret of the Wheat giving way. I may mention, a part of the same field was also sown in autumn after Beans, but it is not affected. Another field alongside, also after Beans, is also unaffected. My neighbouring farmer has already ploughed up a field, apparently suffering from the same cause, and other fields in the district are more or less affected. The seed I used was old Wheat, and was not pickled when sowed. The field which was ploughed up was sown with new Wheat, and pickled in the usual way."

On May 26th Mr. Prain was good enough to add some further details of cultivation as follows:—

"As regards the cropping of the land in this district, it is almost entirely cropped in the eight rotation. That is as follows:—Wheat, Beans, Wheat, Turnips, Barley, Hay, Oats, Fallow.

"The field which has suffered so much on my own farm has been cropped for the last few years as follows, beginning at the Turnips:—Turnips, Barley, Hay, Oats, Fallow (part Turnips), Wheat, Fallow again (with part only Beans), Wheat—the present crop which is so bad. As I explained, the Wheat after Beans is unaffected.

"I have another field of Wheat after Fallow on slightly stronger clay, which has been cropped in the usual rotation given, and it is looking first-class, although the maggot was also present, but not numerous. It was worked the same as the other, the same seed used, and the sowing was finished on October 6th. The bad field was finished on October 19th.

"So far as I can see, the Wheat on easy clay has suffered far more than on heavy stiff clay. Speaking generally, we like our Wheat sown when the ground is pretty damp; that is, when ploughed, we like to see it cutting a little. In this state it leaves a nice clod after harrowing, and is not so liable to be damaged by Snails, or thrown out by frost. This year the autumn was so dry that the Wheat had to be sown with the ground too free; whether this would have anything to do with the maggot or not, I cannot say."

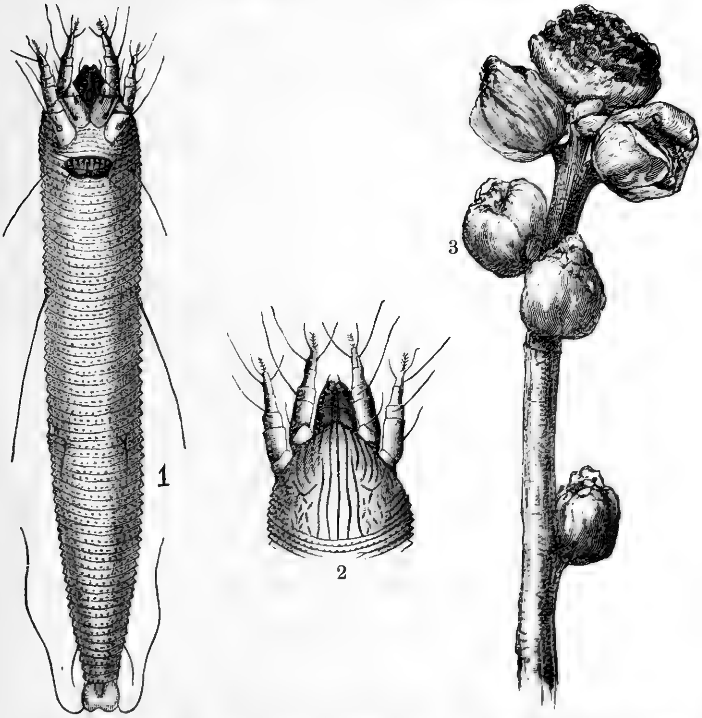
The above notes are given to show that the infestation is still present, and liable to cause much loss, and also to show how much we still need more information as to the life-habits of this Wheat-bulb Fly before being able to suggest any presumably successful means of prevention and remedy.

We do not yet know whether the fly is double-brooded; that is, whether the brood that we know hatches from the chrysalids from about May to July lay eggs on grasses or *somewhere* (at present unknown), from which may arise, in due course, flies laying the eggs to produce the winter grubs.

The remarkable and at present unexplained part of the attack is the fact of its, for the most part, having been observed as following on fallow or exposed land. Details of circumstances of attack are given in various of my Annual Reports referred to, and if any observers could assist us with further information as to life-history, or means of prevention of the pest, it would be a valuable service to all Wheat growers.

CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Nalepa.



PHYTOPTUS RIBIS.—1, mite, greatly magnified—natural length of female 0·23 millimetres; 2, head and fore parts, still more magnified; (by permission, after Dr. A. Nalepa). 3, mite-galls of unusually large size, with one withered and open.

So far as I am aware, the observations of the past year have shown little, if any, practical advance in knowledge of preventive treatment for Black Currant Gall Mite, which still continues to be as great a pest as ever to growers.

It may, however, be of service, in saving waste of time in experiment, and also in saving adoption of useless remedies, to give a few details of severe treatment which there was reason to hope would succeed as measures of *extermination*, but *have failed;* to mention two insecticides which (recommended on authority) have proved valueless; and also to give a few notes on fumigation, regarding which, though proof has been given that it will kill the Gall Mites if thoroughly and strongly brought to bear on them, we do not as yet see how to bring the plan to bear in circumstances where bushes are grown in large areas, even up to fields of several acres.

The history of the attack, as most of us know well, is that from about the middle of July, when the *young buds* of the season are *forming*, the swollen gall-growths may also be found *commencing;* and even at that date the mite may be found in all stages, from egg onward. As time goes on the growth of the galled buds progress till they are very noticeable as green mis-shapen balls of abortive leaves; or, when partially opened, as perishing rosette-like masses crowded within with legions of the *minute cylindrical four-legged mites*, too small to be distinguished by the naked eye.

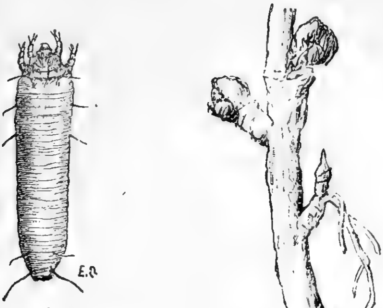
The figure, p. 43, gives a representation of the mite so enormously magnified as to be of service for scientific identification *; and with this is given a figure, *life size*, of the mite-galls, taken from a spray of *unusually* large specimens with one gall expanded, and with the centre withered.

At p. 45 a figure is added showing a spray with two galled buds, and one in the natural state, and also a specimen of *P. ribis*, enormously magnified, but, though not such a perfect representation as the figure at p. 43, giving a very helpful general idea of appearance as seen by *ordinarily* accessible microscopic powers.

In the course of 1898 it was considered desirable by the Director of the Woburn Experimental Fruit Farm to institute some experiments to ascertain whether, in cases where Black Currant plants taken from infested plots were cut down to the ground and removed to ground known to be clean of infestation after having the roots variously subjected to treatment to remove or kill mite presence, this would be followed by absence or by presence of *Phytopti.*

* The length of the female mite is twenty-three hundredths of a millimetre—that is to say, twenty-three hundredths of one-twenty-fifth of an inch—a size at which (it is unnecessary to say) the mites, as single objects, are imperceptible to the naked eye.

It was obvious that, if under the above circumstances mite-galls appeared on the growth from the removed roots, the mites *must* have travelled with the plants, and we should gain the information that the mites did not always spend their whole lives on the "above ground" part of the plants.



1 2

PHYTOPTUS RIBIS.—1, mite, magnified; 2, Black Currant shoot, with two galled buds and one in natural state.

My own garden at St. Albans was especially well adapted for experiment, as to my knowledge from personal observation there had been no presence of mite-galls on the bushes for the whole period which I had known it, namely, since September in the year 1887, and I was very glad to take part in the parallel series of observations.

Accordingly, on November 1st, 1898, a small consignment of six plants of Black Naples, and six of Baldwin's Black Currants, was forwarded to me from the Woburn Experimental Fruit Farm. This dozen of plants had simply been cut down, but nothing else had been done to them; they arrived in due course, and were immediately planted in my garden in a favourable position for growth.

Another consignment, also of six plants of Black Naples and six of Baldwin's Black Currants, was sent me two days afterwards. These had likewise been cut down, but had undergone the further treatment of being steeped (both roots and short remaining portions of stems) for two hours in equal volumes of methylated spirit and water. These also were planted promptly; with the approval of Mr. L. Castle, Manager of the Experimental Fruit Farm, of the localities chosen, and especially of the two consignments of plants being completely isolated.

Of the twelve plants which had merely been transplanted after being cut down, one plant died; of the twelve which had been subjected to the severe treatment of being steeped for two hours in spirit and water, in addition to being cut down, four died. The remainder made growth naturally, and on examination taken early in November, 1899, a few days over a year from the date of planting, those which had merely been removed averaged in number of shoots about eight each, the length of the shoots being about eighteen inches. The plants which had been washed averaged about five in number in shoots, the length of the shoots being about fifteen inches. From the above points it was obvious that the washing was by no means good for the general health of the plants, and it may be further added that, although the simply moved plants appeared excellently healthy, the others were by no means in equally good condition.

The observations of the following year—that is, of the past season (1900)—showed that to some degree all the plants which had been experimented on were *un*satisfactorily affected. All of them flowered profusely, but the luxuriant bloom proved a complete failure, no fruit at all being produced.

With regard to presence of mite-galls, which was the object of the experiment, we found, in observations taken on or about Nov. 7th, that on the eight plants which had survived of the twelve that had been treated by being steeped in methylated spirit and water, there were only two galled buds to be found. But to set against this advantage it should be noticed that, besides a third of the plants having died under the treatment, all of the remaining eight were sickly and some obviously perishing.

Of the twelve plants which had simply been cut down (as mentioned above) and then replanted in my garden, one died, and on examination on Nov. 7th, galled buds proved to be unmistakably present. These were not as yet large, only just small round knobs, but they were numerous, what might be called a fair sprinkling. It is also perhaps worth record that, as far as I noticed, these infested buds were on the lower parts of the shoots, not at all on the *upper* ends or upper parts of the shoots, as has been commonly noticed to be the case.

The presence of the mischief appeared to be entirely limited to the plants, which, as above mentioned, must have conveyed it *on themselves* into my garden, for, on careful examination, my own plot of old-standing Black Currants proved still to be as free from presence of mite-galls as I have found them since the autumn of 1887, when first I knew them.

The result of the experiment appears to be definite proof that, besides presence of the mite (*P. ribis*) in egg or more advanced stage in galls (or possibly also otherwise located) on the higher parts of the plants, it also is to be, or may be, found at the roots or at the *very lowest* parts of the stems, such as were left unremoved on the plants sent me for experiment.

How far this knowledge can be utilized remedially I do not at present see, where considerations regard growing bushes; but I think it shows that we cannot expect anything more than very temporary relief (possibly the shoots of one or a few years) from the treatment of cutting down infested bushes. And also that when an agent (in this case methylated spirit and water) strong enough to destroy *almost* (though not quite) all the mites was applied, that it also at once destroyed a third of the plants, and of the rest caused a thoroughly sickly state, apparently fore-running some of them quite perishing.

This climax, however, I did not wait for, as, *having* found that the bush stumps brought their tenants with them, I thought no object would be gained by further risk of infestation of my own very good well-bearing bushes, and had the experimental plants which were not removed for scientific inspection dug up and burnt.

For detailed accounts of results of careful and elaborately conducted scientific experiments in relation to Currant Gall Mite up to date of publication, the reader is referred to the book mentioned below,* to which doubtless in due time will be added the results of the Woburn experiments regarding effect of removal of cut-down plants to uninfested ground.

One point, however, which I take leave to extract from p. 18 of the above-mentioned work *verbatim*, is certainly of importance practically.

Following on a list of insecticides which have proved *valueless*, it is mentioned that this includes the two which the Board of Agriculture has recommended growers to adopt as a cure, namely, as mentioned in their Leaflet No. 1, petroleum (paraffin oil) emulsion of the strength of one volume to twenty of water, also a 2 per cent. solution of carbolic acid. The strongest solutions used at the Woburn experiments were considerably stronger than those recommended by the Board. "The observations on which these recommendations are based are not quoted, and our own results would lead us to conclude that the adoption of such remedies would entail nothing but expense and disappointment on the grower" (Woburn Report (referred to in note), p. 18).

For a large amount of minute detail of scientific experiment, of great value to all who are labouring in this difficult field of inquiry, the reader is referred to the above-mentioned Report; but some allusions given in its closing pages regarding the subject of fumigation, to which a good deal of attention was drawn experimentally in the early part of last season, are well worth notice.

In "Addendum, May, 1900," at pp. 32–34 of the above Report, it is mentioned that a preliminary account of some experiments on the fumigation of infested Black Currants with hydrocyanic acid by H. H. Cousins has recently appeared in the Journal of the South-

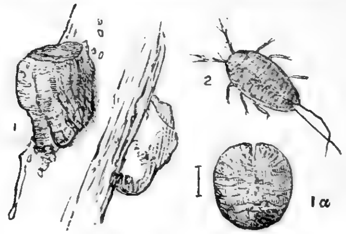
* 'Report on the Working and Results of the Woburn Experimental Fruit Farm,' by the Duke of Bedford and Spencer A. Pickering, F.R.S., pp. 134. 1900. Eyre & Spottiswoode. Price Five Shillings.

Eastern Agricultural College, Wye, for April, 1900, No. 9, p. 67. This is accompanied by some well-based observations as to the difficulties attending broadscale application of the plan, which (that is, possibility of application "to bushes in a plantation") is what we really need. And also, as is noticed, we need more details; as, for instance, in connection with effects of fumigation on eggs of the mite, which we know to be present more or less throughout the year.

The commonplace remedies, or rather attempts at remedies, of this severe pest to Black Currant growers have been so very often entered on that it would be undesirable to enter on them again here; but, so far as I may venture to express an opinion, it seems to me that, where Black Currants are *grown together* in large areas, which render *observation* and *immediate* removal of the very first presence of the mite-galls impossible, the most practically useful way of checking *spread* of the mischief (insufficient as it is) is breaking off and destroying the mite-galls. We know exactly what the cost of this is (at so much a bushel), and this plan, poorly as it meets the trouble, must still demonstrably to *some degree* lessen the amount, and it has the advantage of not wholly sacrificing the crop of the year.

In garden treatment, when a bush or two in an otherwise uninfested plot are found to be infested, it is best at once to remove the plants and destroy them.

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



Pulvinaria ribesiæ.—1, female and woolly egg-sac, magnified (natural size given at p. 50); 1*a*, female Scale, magnified, with line giving natural length; 2, larva, magnified.

The White Woolly Currant Scale has not been noticed as present to any amount worth reporting since 1889, the year in which its presence was first scientifically recorded in this country, until the past season. Specimens of the infestation forwarded in that year were submitted to Mr. J. W. Douglas to obtain certain identification, and were stated by him to be *Pulvinaria ribesiæ*, Signoret, a species found on Red Currant bushes in France, and which he had long expected to hear inhabited Britain, but until that time had not seen it.

In the course of correspondence it appeared that, though specimens had not been previously sent for identification, this white woolly infestation had been noticed on Currant bushes for some few years before, and a glance at the figure on p. 50, taken from a photograph of an infested Currant shoot, will show that for practical purposes the appearance of the attacked shoots hung about with masses of white web and dotted with brown Scale insects is unmistakable.

In the course of the past season notes were sent me, on May 5th, from Petersfield, Hampshire, by Mr. Lavender of his having observed the attack in May of the previous year—that is, of 1899—and although only referring to one attack, this is of some interest with regard to locality.

In the year of first observation, with the exception of Wakefield and Huddersfield in Yorkshire, all the places reported from were in the East of Scotland, namely, from the neighbourhood of Banff, Aberdeen, Stonehaven, Arbroath, Edinburgh, and Berwick-on-Tweed, and *on or near the sea-coast*, excepting in the case of Ballater, in Aberdeenshire, which is not very far inland.

In the recent instance of observation, at Petersfield, this is quite in the South of England, and not far from the sea, as it is about fourteen miles from Emsworth on the north of Chichester harbour, and about eighteen miles by road from Portsmouth, to which (and, I believe, also to Emsworth) French sailing-boats bring cargoes of vegetables, which foreigners hawk about the whole country-side.

The above information, for which I am indebted to Mr. Lavender, suggests a method by which it appears at least possible that this Currant Scale, which is known to be a French infestation, may be distributed in England. In this case Mr. Lavender mentioned that, on May 20th, 1899, he removed from a strong well-grown Red Currant bush of some three years' growth a fine specimen of this "White Woolly Currant Scale," *Pulvinaria ribesiæ*, so closely resembling the illustration of the Scale on a branch at p. 76 of my 'Handbook of Insects Injurious to Orchard and Bush Fruits,' repeated at page following, that it might have been drawn from it. The Scale removed was fully as large, the filaments of white cottony fibre were spreading, and a few yellow-brown seed-like objects (? very young larvæ) were to be seen upon the branch immediately below the Scale, as shown in my illustration.

The presence of the white cottony or woolly matter is one great characteristic of the attack. At first this forms (where it is undisturbed) a thick compact tuft, within which the eggs and the young Scales in their earliest condition are sheltered, and on the front part of which the brown Scale is raised, sometimes almost vertically. At fig. 1, p. 48, the mass of woolly material is shown (much magnified) with


Currant branch infested by White Woolly Scale.

the brown roundish Scale at the upper end lying almost at right angles to the Currant shoot. In the accompanying figure* of an infested branch, these roundish dark Scales are very noticeable lying amongst the white wool. *At first* this forms a white oval mass, but afterwards the filaments become drawn in all directions, until at a distance the infested branches look very much as if they were covered over with white-wash.

The Scale itself is one-sixth of an inch in length, and about three-quarters of its length in width, of a squarish oval, with the hinder extremity notched or heart-shaped; the colour reddish brown, sometimes dark grey brown. A line which is more or less raised along the back gives it, to some degree, the appearance of being keeled; and on each side of the body it is wrinkled and faintly pitted (when dried the wrinkles are not very observable). See fig. 1*a*, p. 48.

The minute eggs, or egg-like bodies, in the wool sent me in 1889 proved, when examined on July 2nd, to have hatched, and the orange-coloured larvæ were dispersing themselves in vast numbers in the box in which the spray of infested Currant was fastened. These minute creatures, which differ in being six-legged and exceedingly active from the immovable and legless state to which they presently turn, were of shape figured at "2," p. 48—

* From a photo taken for me by Messrs. West, Newman & Co., 54, Hatton Garden, E.C.

that is, of a flattened oval, broadest near the head; deeply cleft at the tail, with a long hair, or filament, on each side of the cleft, and in the centre of the cleft a long cylindrical process. The body was somewhat raised along the centre with side ridges from it, and the surface slightly sprinkled with white or woolly morsels. Eyes dark or black.

Although perhaps mention of the following distinctions are not of any great use in British identification, it may be observed that this Scale (*P. ribesiæ*) is distinguishable from the nearly-allied species *P. vitis* by being " smaller, thicker, rounder, more heart-shaped, and of a deeper brown " ; and in larval state by being of a longer shape, with shanks and feet much shorter, and half less in size. Also the larvæ of *P. ribesiæ* bear five hairs, those of *P. vitis* six. These minute distinctions cannot be easily conveyed in a figure only so much magnified as that at p. 48 ; but detailed description will be found in the work quoted below.*

One special characteristic of the genus *Pulvinaria* is that the female forms an " ovisac "—that is, a bag for the eggs ; scientifically stated, " the females after fecundation secrete below and at the posterior end of the body a mass of cottony material, which forms a nidus for the eggs." †

For practical purposes as a Currant attack the white mass with the dried-up Scale at one end and the white filaments scattered in untidy bunches on the bushes are quite enough for identification, and the life-history is much like that of Scale insects generally. The little larvæ come out from the sheltering cottony secretion beneath (or by what is by that time the mere dead brown husk of) the mother Scale, and disperse themselves in great numbers and with great activity (by means of the six legs which they possess in early life) on the bushes, where they have a capability of doing much harm by piercing into the bark and drawing away the juices with their suckers. I have found them present in extraordinary numbers at the beginning of July. In due course these larvæ settle down into stationary pupæ, and in the case of the female produce, as mentioned above, the eggs which lay the foundation of the next generation.

The various observations sent show that the Woolly Scale infests the Black Currant, as well as the red and white kinds, and likewise the ornamental kind, *Ribes sanguineum*, sometimes known as the " Flowering Currant."

* See 'Essai sur les Cochenilles, 15, *Pulvinaria ribesiæ nobis*,' par M. le Docteur Signoret, p. 219, vol. i. of Collected Essays. Translation also given in my 'Thirteenth Annual Report,' p. 44, and 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 76.

† 'Report of Entomologist for the year 1880,' by J. Henry Comstock, p. 334; Washington, 1881.

With regard to methods of prevention and remedy. As the attack is so seldom noticed, these seem hardly to need special mention; but it may be worth while to note that 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; consequently, all measures of good cultivation adapted to keep the branches or the bushes from being crowded up together or overshadowed would be useful, as also keeping a watch on Currant branches nailed to walls, where any infestation which especially affects the sheltered or under side of branches has every chance of establishing itself. In many cases probably, at least where attack was bad and the Currant bushes could be spared, the very best course would be to cut them down and burn them, and so save risk of spread of the infestation.

In regard to remedies, it is somewhat curious that applications of soft-soap and also of paraffin oil should be reported as useless. But as kerosine emulsion has been found a successful application in the United States of America for destroying the eggs of the allied species, *P. innumerabilis*, it is presumable that this or the very similar English mixture sold under the trade name of Anti-pest (for which see Index) would have very useful effects.

The only remedy noted as quite successful was that applied by Mr. William M'Kenzie to infested bushes in the gardens under his charge at Glenmuick, Ballater, Aberdeenshire. This consisted in applying "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 of the same consistency as is used for whitewashing walls," and the application proved to be a permanent and effectual cure.

MUSTARD.

Gamma or Silver Y-Moth. *Plusia gamma*, Linn.

PLUSIA GAMMA.—1, eggs; 2, caterpillar; 3, chrysalis in cocoon; 4, moth.

Towards the middle of the past summer information was sent me, with specimens accompanying, of caterpillars (which proved to be those of the Gamma or Silver Y-Moth) having been causing serious injury to Mustard, and also to Potatoes. In the first case the attacked locality extended for a distance of fully twelve miles in fields adjoining the Humber; in the second, the mischief was reported especially from the neighbourhood of Holbeach, in Lincolnshire.

The attack is of unusual interest from several points of view, but most particularly because, although these voracious and good-sized caterpillars are very general feeders—as, for instance, on the leafage of Peas, Beans, and Clover, Turnips and Cabbage, Beet and Mangolds, and various other crop and weed plants—yet I have no knowledge of Mustard having ever been recorded as one of the plants on which they feed; and excepting in 1892, when I had two observations from localities in Kent of the migration of this species of caterpillar to Potatoes from Clover, I have never had notes of them as an infestation to Potatoes.

In the following pages I have placed the observations under one heading as above, referring back to it from that of Potatoes, placed in its regular order, as from various coincident circumstances the attacks are most usefully recorded together.

The Gamma eggs are generally laid beneath the leaves, and soon hatch. The caterpillar (figured above, life size) is, when full grown, usually green, and covered with short hairs; the head brownish green. It has six fine whitish lines along the back, and a fine yellowish line along each side; the three pairs of claw-feet green or reddish brown, and the *two pairs* of sucker-feet beneath the body green. One great point of distinction in these caterpillars is that they have only these two pairs of abdominal sucker-feet. A very large number of our common crop caterpillars have *four* pairs, and walk, or creep, evenly onwards. Some of our most destructive orchard caterpillars have only *one* pair of these abdominal sucker-feet; consequently, as the hinder half of the creature has to be drawn up to the foremost before it proceeds on each step in its travels, it forms an upright arch, or "loop," in walking, and is thence called a "looper." The Gamma caterpillars, having two pairs, do not need to form a quite complete loop, and are therefore known as semi-loopers, and the distinction is worth bearing in mind, as a help towards identification.*

When full-fed, the caterpillar changes to a dark-brown or black chrysalis, visible through a woolly open-work cocoon, which it spins, possibly on its food-plant, but very likely on any plant near, whether cultivated or otherwise, and in bad attacks the cocoons are very noticeable, as on corn, Dock, &c., and especially on Thistles. In the past season some excellent specimens of these net-work or woolly cocoons were sent me, from which the moths, both in the case of the Mustard and the Potato attacks, began to appear from the 4th to the 6th of August.

There are, or may be, two broods yearly, of the second of which the caterpillars live (according to German observation) through the winter; and moths apparently also occasionally hybernate.

The moth, though not appearing often as a bad crop infestation, is very common in summer and autumn, and is chiefly distinguishable by its fore wings, which are about or upwards of an inch and a half in expanse, and of a satiny glance, or sometimes of a purplish or coppery lustre, with brown or grey markings, bearing in the centre of each a pale or silvery figure like the letter "Y," from which the moth takes one of its popular names.

The following notes which I was favoured with by Mr. H. L. Lennard, of Preston, Hull, are of much valuable interest. It will be seen that they give the date of first observation of caterpillars whilst

* The colours appear to vary, or at times to vary with age, sometimes to be of dark green with a mixture of brown, and sometimes they are considered to vary in colour with that of the leafage on which they are feeding; this presumably from the leafage showing through the skin. A description has been given (see 'British Butterflies and Moths,' vol. vi. pt. iii. pp. 112–114) of a smaller form of larva, only about an inch in length, and darker in colour, from which such few moths as developed were smaller and lighter than the ordinary species. It is especially mentioned by the well-qualified entomological observer that he is satisfied the colouring of the larva was "not due in any way to disease or feebleness"; otherwise from his mention that "all the larvæ, when full-grown, were very small"; also that probably half of his "died without spinning at all, and from those that did spin and change to pupæ, only one moth managed to emerge"; it might be conjectured that the specimens were not so much a variety as a diseased and stunted form.

still few in numbers and small in size about July 12th; that about a fortnight later, on attention being drawn, by the multitude of starlings upon the Mustard crop, to something unusual occurring, vast numbers of caterpillars were observed, then advanced in growth and causing much damage, of which estimate is given; that at date of writing, Aug. 3rd, the caterpillars had turned to chrysalis state; and also that no great numbers of this Gamma or Silver Y-Moth had been *previously noticed;* also attention is drawn to the very practically interesting point that, whilst fields near to the bank of the Humber for a length of ten or twelve miles were more or less affected, fields a *little inland* were not perceptibly damaged. I append Mr. Lennard's observations in his own words:—

"When I was going my round amongst the Mustard growers on the 12th and 13th of July last, I noticed several small green caterpillars, but never thought of their injuring the crop. On my return from my holiday I find that the attention of the farmers was drawn to their Mustard about the 23rd by the great numbers of starlings upon it. On examining the crop they found thousands of caterpillars about an inch to an inch and a half long, which were eating the leaves and the young pods, and *during the week* damage was done to the extent of about two to four sacks per acre.

"At the present time the pest is in its chrysalis state, of which I send you specimens. I notice a peculiarity (which will probably not be one to you) that in the majority of cases there are two chrysalids in each cocoon, though there are more in some. I shall be obliged if you will tell me the name of the moth, and also your opinion as to the probability of its being present again another year. I hope it may be as in the case of the Diamond-back Moth, which, though it did great damage a few years ago to the Mustard, yet in the following year none were to be found.

"Amongst the peculiarities of this visitation are:—

"No great numbers of the moth have been noticed, either in the earlier part of this year or in previous years.

"Every field near to the Humber Bank, in a length of ten or twelve miles, is more or less affected, whilst those fields a little inland are not perceptibly damaged. This would make it appear as if the moth had *come across the sea;* if it had come from the Lincolnshire coast, it would have been heard of."—(H. L. L.)

The specimens forwarded by Mr. Lennard proved to be *P. gamma*, of which the first moths appeared from the cocoons sent on the 5th and 6th of August.

To the above communication Mr. Lennard added a request that I would not at that time draw attention to the severe nature of the attack for fear of causing alarm, but that later on he would send me a full report of the infestation of the "Gamma" on the Mustard after he had been round again, and had obtained all information possible.

"In Lincolnshire," Mr. Lennard added, "it has attacked the Potatoes. On the worst damaged Mustard crop here, Potatoes are grown in the next field (the headland only separating them), and they are not touched; whilst on the other side is a field of Swedes, where eight rows have had the leaf completely stripped off, the rest of the field being undamaged. *Thistles* and *Hairiff* have had their leaves completely stripped off by the caterpillars."—(H. L. L.)

In compliance with his promise to give me a more detailed note regarding the attack, Mr. Lennard favoured me with the following report, in which, in the first part (which was dated August 2nd), further information is given regarding the vast numbers of the infestation, their voracity, and their method of attack to the Mustard. In the addition, dated Sept. 5th, Mr. Lennard again mentions the severe damage that had been caused, and again alludes to the caterpillars having been reported to have done much harm to Potatoes in Lincolnshire. Mr. Lennard wrote as follows:—

"I am sorry to inform you that serious damage has been done to the growing crops of Mustard seed in Holderness. On the 13th of July I noticed several small green caterpillars on the plant, which, however, looked particularly healthy; but when I returned from my holidays on the 30th, the farmers told me that their crops were covered with caterpillars about an inch long, and were very badly damaged. I went to see the crops again yesterday, and could scarcely believe it possible that so much injury could have been done in so short a time. The pest was then in a chrysalis state, millions of them hanging on the plant in cocoons or webs. I send some specimens which I hope may hatch out, so that you may recognize it.

"I think the moths, in the first instance, must have come across the North Sea, as every field adjoining the Humber for a distance of fully twelve miles is more or less seriously damaged—the worst being to the plot, one of fifty acres, nearest the mouth of the river; here the damage cannot be less than £5 or £6 per acre, on others it will be £2 or £3, whilst half a mile, or even less, inland no perceptible injury is done. The total damage will probably be £800 to upwards of £1000. Had it not been for that best of the farmers' feathered friends—the Starling—the damage would have been much more serious; immense quantities of these birds could be seen feeding on the grubs the whole day long. The caterpillars are evidently most voracious feeders. They first eat off all the leaves of the Mustard plants, and then the more tender pods and bark; several of the side branches are completely stripped. In addition to this they eat such plants as Hairiff and Thistles, nothing being left but the bare stalk.

"Sept. 5th. I regret to say I have in no way underestimated the damage done to the Mustard by the caterpillar of the Gamma Moth (as recognized by you); now that the crop is cut I can speak with certainty.

"I understand that in Lincolnshire Potatoes have suffered serious injury from the same insect."—(H. L. L.)

The following observations refer to the appearance of the Gamma caterpillar, and were sent me by Messrs. W. J. Coleman & Sons, of South Side, Covent Garden, London, W.C., on July 31st:—

"We are growers of Maincrop Potatoes in the district of Holbeach, Lincolnshire, and within the past ten days the haulm of this description of Potato has been seriously attacked by a green caterpillar about one and a half inches long, which may involve the loss of half the crop. The Potatoes had previously been sprayed with Strawsonite, and sprayed with a mixture of soft-soap and paraffin since the appearance of the caterpillar, but without effect. We enclose you specimen of the bine, or haulm, with some of the chrysalids, as we do not remember such an occurrence previously. We may add that other sorts of Potatoes do not at present appear to be affected."—(W. J. C. & Sons.)

On August 2nd Messrs. Coleman further wrote that, as the point of identification was of material interest owing to the many thousands of acres of the above-named kind of Potatoes grown both here and in Scotland, they had asked their agent at Holbeach (Lincolnshire) to send me some fresher specimens of the Potato-haulm, the caterpillar, and the chrysalis, and samples were accordingly forwarded to me from Holbeach, Lincolnshire, on August 3rd by Mr. Canwell.

These, as well as the specimen sent me by Mr. Lennard, proved to be of *P. gamma*, from which, on the following day (the 4th), I found the moth had begun to develop. In this case I was fortunate enough to have the infestation in all three stages—that of the green "*semi*-looping" caterpillar with the two pair only of abdominal sucker-feet; of the chrysalis with the almost spike-like process beneath it; and of the moth, characterized by the white Y-like figure on the upper wings, from which it takes its common English name.

The above notes are of a good deal of interest, as showing the capacity of this Silver Y-Moth of causing very serious injury over a large area to two important crops, neither of which appears to have been previously recorded as infested, excepting in the two instances noticed at p. 53, when the caterpillars, having in one locality "cleared" the Clover fields, and in the other eaten all of the "young shoots of the Clover," migrated in search of food to the neighbouring Potatoes.

In regard to the cause of the past year's attack, I should conjecture, from the evidence given, that it might reasonably be supposed to be wind-borne from some other country. The attack, or at least the presence of this species, is to be found all over the Northern Hemisphere, from Greenland to Abyssinia, and all interested in the subject are well acquainted with the memorable migration of vast hordes of this *P. gamma* across Europe in 1879. In this case the swarms left North Africa in April, and, passing by way of Spain and Italy, traversed Europe, doing serious injury by the caterpillar devastations they gave rise to in their transit, and reached our shores early in June.

From the notes sent me of the attack of the past season, there does not seem to have been observation of previous presence of the moths, and the coincidence of date of appearance of the attack in its different stages, on the *two different kinds of crop in the two localities, is noteworthy.* The beginning of the caterpillar mischief must have occurred at about the same date, and, from the specimens of pupæ in their cocoons sent to myself, the first moths emerged with only a difference in date of one or two days.

Measures of prevention and remedy seem hardly worth entering on, as the attack is one that rarely occurs to an amount to cause serious damage.

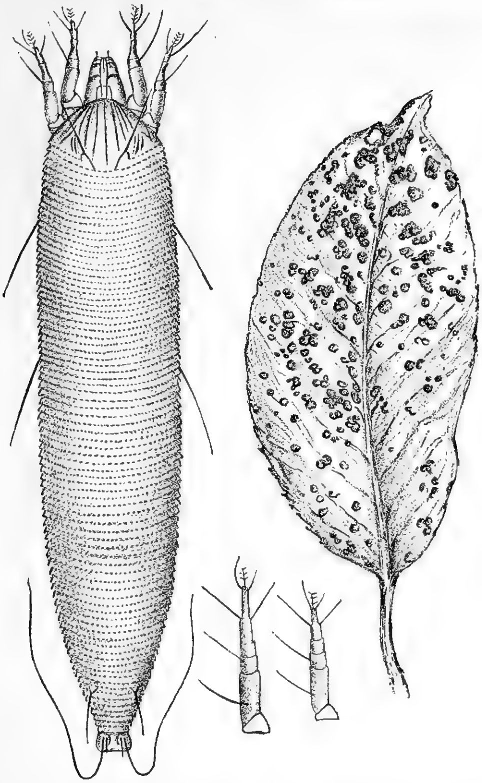
On the face of the thing it might be supposed that spraying with some good insecticide might clear the pests; but amongst Messrs. Coleman's notes it is mentioned that the Potatoes especially under observation were sprayed, after the appearance of the caterpillar, with a mixture of soft-soap and paraffin, *but without effect.*

One of the more poisonous insecticides would, of course, be surer in its effects on the caterpillars, but its use, at least on the Potato leafage, might be objected to.

Where the attack is on a small scale, as in gardens, hand-picking the larvæ would be a sure way of abating the nuisance; and with regard to the chrysalids contained in the very observable cocoons, where these are in the vast numbers sometimes observed in localities where attack has been severe, it could not fail to be of use to have these collected and destroyed; but, so far as I am aware, beyond desirableness of checking caterpillar attack whilst in progress, there is no reason to take trouble, or go to expense, to prevent a following year's recurrence of mischief.

PEAR.

Pear Leaf-blister Mites. *Phytoptus pyri*, Nalepa.



Phytoptus pyri.—Female; natural length circa 0·2 mm.; left leg of the first pair of *P. tristriatus*, and (smaller figure) of *P. tristriatus* var. *carinea*, magnified 550 times—all after Dr. Nalepa. Infested Pear leaf.

The harm caused by the Pear-blister or Gall Mite to Pear leafage appears to be of old standing, and commonly met with; but from the reason of its presence not being generally recognized, remedies are not applied as is desirable.

The mites which cause the mischief are of the same nature as the *Phytoptus ribis*, or Black Currant Gall Mite, with which at present we have not been able to cope satisfactorily on our Black Currants. Like them, they and the others of the subfamily of *Phytoptidæ* may be distinguished from all others of the order *Acarina*, to which they belong, by their cylindrical shape, and by having throughout their lives *only two pairs of legs*, which are placed (as shown in the enormously magnified figure of the "Pear Blister Mite," given at p. 59, and in those of the "Black Currant Gall Mite," given at pp. 43 and 45, preceding) *at the fore part of the body.* They propagate by eggs, but, whether in egg or mite condition, are too small to be made out without the help of a magnifier.

The presence of the infestation, however, may be surely known of by the various colours and other characteristics of the infested leaves, as to some degree shown in the figure of the Pear leaf (natural size) accompanying that of the Leaf-blister Mite.

The history of the mites, as given by various observers, is that they pass the winter in embryo, as well as in fully developed state, in the leaf and flower-buds of one-year-old shoots, "embedded in the layer of hair or downy felt inside the outer bud-scales," and as many as seventeen specimens are recorded as having been found together. From these scales the mites come out early in the spring, and attack the young unfolding leaves. It has been considered that the mites *commence* their infestation on the lowest leaves of the twigs, leaving the upper leaves free at first; and therefore that clearing the lower leaves from the shoots where attack is seen to be taking possession would have a good effect in checking progress of the mischief.

The disease shows itself in the form of little blister-like spots, somewhat raised *on each side* of the leaf, but to which access is given by a small central hole on the *lower side* of the leaf. The eggs are laid within these blisters, and the central hole serves as a means of passage to the mites, which spread themselves at their pleasure, and very possibly carry on their attacks throughout the summer, until a large part of the leaves are seriously injured for all serviceable purposes.

The little blisters at first may be red, or they may be red on one side of the leaf and green on the other. With advance of age the blisters become spongy in texture, and brownish or blackish in colour, and before the leaves fall the mites leave the galls (blisters), and secrete themselves amongst the scales of the winter buds (as before mentioned) for the winter season.

The above characteristics are quite sufficient guide for identification of the nature of the attack. If anything more is required to distinguish it with certainty from the discoloured patches sometimes found on Pear leaves, and known by the name of "Pear Scab," it is enough to notice that in the mite-gall attacks there is a swelling of the blister on *both sides* of the leaf, with a central *hole below;* and if a section is cut through the blister, the diseased tissue will be found to form something of a cavity between the two sides of the leaf, within which (with the help of a magnifier) the minute, cylindrical mites, in different stages, and their eggs will very likely be found.

On May 17th in the past season the following communication, with specimens accompanying, was forwarded to me by Mr. R. Lewis Castle, Manager of the Woburn Experimental Fruit Farm, near Ridgmont, Aspley Guise, Beds. As will be seen, it draws attention (though without any mention of it being present on Pears in the experimental grounds) to the general prevalence of the attack :—

"Are the enclosed leaves attacked by *Phytoptus pyri?* I am afraid that Pears are suffering rather generally this season from similar attacks."—(R. L. C.).

The specimens consisted of young Pear leaves, mostly about one and a half to two inches in length—measured without the footstalk; in most cases sprinkled numerously with small blister-galls on both sides of the leaf. These were chiefly of some shade of red, or pale red, sometimes pale green at the edges. The shape of the blister-galls was irregular, being often of small roundish spots, but sometimes forming blotches, as of several galls united. From the young condition of the leafage (particularly after injury in postal transmission), there was some difficulty in observation of the central aperture in the gall beneath the leaf, but by carefully tearing or cutting some of the leaves across, so as to obtain a cross section of the blister, I was able, with the help of a two-inch focus glass to obtain a clear view of the blister-gall, as a slight elevation on each side of the leaf, with the aperture, or central orifice beneath.

Some of the leafage on my own wall Pear-trees was very badly attacked; but as we know the attack to have been prevalent, it is not necessary to give further details of localities of observation. Full accounts will be found in my Annual Reports for 1893 and 1894; and in the latter, at p. 87, I mention that the attack "does much harm in some places, and appears to be steadily increasing, partly by reason of the damage noticeable on the Pear leaves not being so well understood as it ought to be"; and also because *reliable measures* for keeping the attack in check had been (up to date) little known in this country.

As both of the above-mentioned reasons for continuance of mischief which might be easily avoided seem still to continue, it seems desirable to allude to the attack again, and methods found useful in checking it.

Prevention and Remedies.—The application which appears to have been found most satisfactory is "kerosine emulsion" (for method of preparation of this see Index). I have very good notes of this, sent by an English correspondent, as arresting attack when applied to trees slightly affected, by a Knapsack Strawsonizer early in May; and also that—in the case of four horizontally trained Pear trees, which previous to the application "had hardly a sound leaf left," and the tender young leaves were all still rolled up—after application of the emulsion the new leaves, up to date of observation, continued healthy.

In the report of Dr. J. Fletcher, Entomologist of the Department of Agriculture, Canada,* giving some good information on the life-history of this Pear-leaf attack and *practicable* remedial measures, it is stated that, "as a remedy, kerosine emulsion seems to be the only substance which, up to the present time, has given any promising results."

From the results of the elaborate experiments carried on at Cornell University Experiment Station, detailed by Mr. Slingerland in the Bulletin mentioned below,† it is considered that "the most vulnerable point at which the disease can be attacked on a large scale is when the mite is in its winter quarters in the terminal winter buds"; and trial of effect of kerosine emulsion proved very satisfactory.

From the summary given of results, it appears that the Pear Leaf-blister Mite can be nearly exterminated by *one* spraying of the Pear trees (at any time *after* the leaves have fallen off in autumn, and *before* the buds have begun to swell in the spring) with kerosine emulsion diluted with *not more* than five to seven parts of water; the tree being sprayed thoroughly from every side, taking especial care to hit every terminal bud, as this is where the mites are stated to congregate.

Where those concerned have the knack of mixing the mineral oil and solution of soft-soap, of which kerosine emulsion is composed, so thoroughly together that they will not separate again and distribute themselves in their previous un-incorporated condition, this application is obviously a very desirable remedy. But the thorough incorporation of the ingredients is hard to manage, and separation is liable to cause much mischief.

Very possibly any mixture of soft-soap with a *little* paraffin stirred into it would do good, and almost certainly the mixture sold as "Anti-pest" by Messrs. Morris, Little & Son, of Doncaster, would answer excellently. This is similar in all essentials to the kerosine emulsion of the U.S.A., but, being sold in a mixed state, only needing diluting, much risk and time are saved by its use.

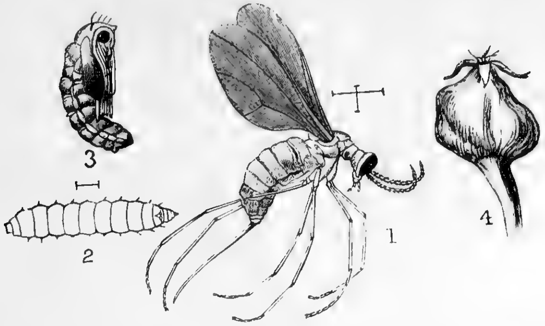
Where circumstances allow of the infested leaves being picked off and destroyed, it is very desirable that this should be done.

The above notes contain the main points requiring observation and attention in order to keep this attack in check, but given shortly to avoid unnecessary repetition. They will be found in detail in my Seventeenth and Eighteenth Annual Reports before alluded to.

* See "Report of the Ontario Fruit-growers Association," p. 113; published in the 'Annual Report of the Department of Agriculture of Ontario for 1892.'

† Bulletin 61, Dec. 1893. Cornell University Agricultural Experiment Station. By Mark Vernon Slingerland. Published by the University, Ithaca, New York, U.S.A.

Pear Gnat Midge. *Diplosis pyrivora*, Riley; *Cecidomyia nigra ?*, Meigen and Schmidberger; *C. pyricola ?*, Nordlinger.



DIPLOSIS PYRIVORA.—Female, magnified; lines showing natural size. Larva and pupa, magnified. Abortive Pear. Gnat and pupa, after Prof. Riley.

The observations of the Pear Gnat Midge during the past season call for notice, as (connected with those of the two preceding seasons) they show the attack as being now widely injurious, and with a capacity of spreading where *not* attended to; but also that, *where* duly attended to, much may be done to keep the destructive maggot attack in check.

As I cannot easily give the main points of the life-history of the Midge, and the method of the attack, in shorter form than as I have condensed them at p. 98 of my Twenty-third Annual Report, I append them with very little alteration.

The method of egg-laying is considered to be that when the Pear blossom-buds are so far advanced as for a single petal to show itself, the Pear Midges deposit their eggs within by piercing the petal with the ovipositor, and laying their white longish eggs, up to as many as ten or twelve in number, on the anthers within the still unopened blossom-bud; but they have been recorded by one observer as egg-laying in the open blossom. The eggs are stated to be so quickly hatched in warm weather that the little larvæ from them may be found on the fourth day after deposit. They bore into the core of the embryo Pear, where they separate and eat away the substance in different directions.

The maggots are about one-sixth of an inch in length, narrow, legless, smallest at the head and tail. Within the young (or it may be said the *embryo*) pears the midge maggots live and feed until they have attained their full size, which may be about the beginning or middle of June, and the infested pears may often, though not always, be known by their knobbed irregular growth and discoloured patches. At this stage—that is, when the young Pear is destroyed by the mischief within—the fruit usually cracks or falls to the ground, and the maggots leave the fruit by way of the open cracks if it remains on the tree, or, if it falls without cracking, may remain for some weeks inside. In either case they bury themselves in the ground, and (quoting from Prof. J. B. Smith; for reference, see note below) go down to a depth "varying somewhat with the condition of the soil, from one-half to two inches, and there they lie for some time unchanged. About midsummer the larvæ make oval cocoons of silk covered with grains of sand, and in these they lie unchanged until early spring." There appears to be a difference of date of time of the maggots forming cocoons, and turning to pupal or chrysalis state within them, possibly from not being in quite natural circumstances; but in regular course, whatever the exact date of pupation may be, the Gnat Midges come out of the ground in spring ready to attack the blossom-buds of the Pear.*

The Pear Gnat Midge (*D. pyrivora*) is a very small two-winged, gnat-like fly, about the twelfth of an inch, or rather more, in length (see figure, and lines giving natural length, p. 63), of a general greyish or black colour; but when looked at more in detail, the head will be seen to be black, with a tuft of yellow hairs, and the body between the wings also black, but with some grey markings and varieties of tint, according to the direction in which it is looked at. The two wings are dusky, clothed and deeply fringed on the hind margins with black hairs, and with a tuft of yellow hairs at the root of each wing. Abdomen dark brown, with long whitish hairs; legs also brown, and also clothed with white hairs, chiefly on the upper surface.†

To save some amount of trouble to readers, I have preceded the following communications, in each case, with a few lines regarding the most important points of the observations.

On Dec. 13th Mr. Geo. Brown, in reply to my enquiry as to amount of prevalence of the Pear Gnat Midge in the gardens of the Marquess of Lansdowne at Bowood, Calne, Wilts, was good enough to send me the following satisfactory report, for which I am greatly obliged, as I was aware that preventive treatment of the infestation had been carried on there for the past two or three seasons under Mr. Brown's own skilled superintendence.

It will be seen that much good has been effected by *trenching* under the infested trees, and also by hand-picking. Mr. Geo. Brown's communication was as follows:—

"I am very pleased to be able to give you a favourable report on

* For much useful information on this attack, see "The Pear Midge (*Diplosis pyrivora*, Riley)," Bulletin 99 of New Jersey Agricultural College Experimental Station, April 4th, 1894.

† For full description of the *imago*, or Gnat Midge, of *D. pyrivora*, see paper on this insect by R. H. Meade in 'Entomologist,' vol. xxi.

my success in carrying out the means you were good enough to recommend to me for destroying the Pear Gnat Midge, *Diplosis pyrivora*.

"During last winter I trenched the ground under the trees, and in that way destroyed most of the larvæ deposited in the surface soil. This year, in contrast to former years, the attack was comparatively slight; and, as an effort to complete the destruction of the pest, I made it a daily operation to go carefully over the trees and pick and destroy by burning all the infested fruit, *not allowing any to drop on the ground.* Where this course is practicable, I believe it to be the most effectual method of eradicating the pest, for otherwise, should any of the infested fruit drop on the ground, there is always a chance of some of the larvæ escaping to continue the mischief in the following year.

"Owing chiefly to the attack of *Diplosis pyrivora*, the Pear crop here has, for a number of years prior to this, been a complete failure; this year, however, the crop has been an excellent one."—(G. B.)

The following notes, which were sent me by Mr. H. H. Williams, from Pencalenick, Truro, Cornwall, on May 18th, in the past season, give valuable testimony to the serviceableness of hand-picking and destroying the young pears infested by the maggot, with a few remarks well worth attention. Likewise, it is noted that the "Pitmaston Duchess" Pear is a kind peculiarly liable to attack, a circumstance which is confirmed by the observations, sent me a little later, by Mr. H. F. Getting, from Oakleigh, near Ross (see p. 66).

On May 18th Mr. H. H. Williams wrote as follows :—

"I am to-day sending you some pears attacked by the Pear Midge, which pest, I am glad to report, is proportionately much less destructive this year than a year or two ago, considering the enormous crop of pears that set this season.

"After three years' trial of the methods advised by you, I feel sure that hand-picking and destroying all diseased fruits is the *only* real remedy. Kainite is doubtless an auxiliary, but, from my own observation, this alone is not sufficient; while hand-picking, if thoroughly done every year, will reduce the attacks to almost negligible proportions in a fair fruit year. I would again draw attention to their marked preference for Pitmaston Duchess over all other pears grown here, while Louise Bonne, as usual, is almost untouched.

"In conclusion, my experience is that when thoroughly done hand-picking is a certain cure in time, but where this is not or cannot be done, Pear growing in the open had better be discontinued at once."—(H. H. W.)

Of the little pears sent, such as showed some degree of infestation were characteristically attacked—that is, showed presence of the Pear Midge Maggot—and the substance of the young fruit was in course of being eaten away.

In the following note from Oakleigh, Ross, Herefordshire, sent me about ten days later—that is, on May 28th—by Mr. H. F. Getting, it is observed that the application of kainite (when followed by dry weather) did no good; also that the fruit of as many as thirty "Pitmaston Duchess" Pear trees was remarkably severely attacked. Mr. Getting remarked:—

"I am sorry to say that the Pear Midge grub is just as bad as ever with us this year, notwithstanding that all the ground under Pear trees was given a heavy dressing of kainite last year early in June. I do not know if the very dry weather after application rendered it inoperative? Mr. Campbell and I decided, as the soil at Glewstone did not suit pears, to remove all but about thirty fine Pitmaston Duchess trees last winter. These trees, which are left, have a heavy set of fruit, and, as far as I can judge, nearly every fruit is attacked.

"I may mention there is a garden within one hundred yards, in which there are Pear trees attacked with the Midge; also old Pear trees in orchards within half to three-quarters of a mile.

"I may mention I sprayed the Pear trees when the blossom was in bud this spring with paraffin and soap emulsion, but without beneficial result."—(H. F. G.)

On June 5th, after communicating with Mr. Getting, he wrote me that he purposed to-morrow to hand-pick the pears, which, as far as he could see, were all attacked by the Midge Maggot. "Also," he mentioned, "I am endeavouring to induce my neighbours to do likewise. This is a more difficult matter, as some of the trees are old orchard standards."

This matter of clearing infested fruit before the maggots are leaving it to shelter in the ground is *the* point of all others to be attended to as a certain preventive, but one that, for a good many obvious reasons, it is often very difficult to carry out fully.

In the following letter, sent me by Mr. F. W. Thomas, of Wannock Gardens, Polegate, Sussex, on (I think*) the same day as the preceding, he particularly draws attention to the importance of clearing infested fruit, and was exerting himself personally to make a "broadscale" clearance in the neighbourhood:—

"Notwithstanding all trouble taken last year the Pear Gnat Midge has made its appearance again this spring, and trees which have hitherto escaped are affected. I have cut down and burnt all large trees, and have picked all the fruit which shows that the maggots are within—they are easily distinguished from the rest—so I am in hopes of not leaving a single fruit in the neighbourhood to make stock for next year. I have also got permission to go round all the gardens in this district and gather all pears which show signs of the pest."

* The date was accidentally torn off.

The following note, sent me on June 7th by Mr. Crawford-Moore, from Nightingale Hall, Edmonton, N. (which was accompanied by samples of infested little pears, about half to three-quarters of an inch in length), shows bad presence of the maggot as a regular orchard pest:—

"I shall be very much obliged if you will tell me what kind of fly produces the grubs in the pears, a sample of which I send you, and what course should be taken to prevent the damage. I have a large orchard, which I have lately taken to, and the Pear trees in it are all affected in this way. There are a great many Pears on the trees, which look fairly healthy, though they have been much neglected for some time."—(J. C.-M.)

The following notes, for which I am obliged to Mr. James Hiam, of The Wren's Nest, Astwood Bank, near Redditch, show serious prevalence of mischief from *D. pyrivora*:—

"The Pear Midge Maggots have been very destructive this season; one large grower told me he had lost ninety per cent. of his crop, and another—who took to Mr. Gibbons', late Chairman of the Evesham Pests Committee—estimated his loss at seventy-five per cent. In other cases not a single Pear escaped attack."—(J. H.)

The following short note, extracted from "Agriculture" in 'The Times' of Monday, July 9th, 1900, gives interesting information as to the serious extent to which the mischief from Midge attack was noticeable:—

"Pears are not, as a rule, over plentiful. The season did not suit some of the early kinds, and the Pear Midge, *Diplosis pyrivora*, has been unusually prevalent. Under many trees the little deformed pears lie thickly on the ground, with their cores perforated by the larvæ of this insect.

Prevention and Remedies.—These turn for the most part on the circumstance of the maggots falling to the ground from or in the fruit, and burying themselves a very little beneath the surface, where they go through their changes to the perfect Gnat Fly.

The infested little pears may easily be distinguished by their stunted lumpy growth, often accompanied by black or blackish spots or patches. Where these attacked fruits are in reach, they should all be picked off *before the time has come for the grubs to leave them* and go down into the ground, and they should all be destroyed (*not* merely thrown aside).

Where the fruit cannot be reached for hand-picking, some good may be done by shaking down; and this is the point in orchard Pear-growing, as shown by the past season's observation, which is particularly needing attention. By spreading cloths under the trees, and shaking and jarring thoroughly, many of the infested fruits, with their maggot contents, will fall, and can be gathered together and burnt; but in all likelihood some may have previously fallen (or the maggots out of them), and some may still remain on the trees. To meet this difficulty no plan seems likely to answer (so far as shaking down is concerned) excepting carrying this out from *time to time;* or more especially *keeping* cloths smeared with grease or with tar in moist state under the trees, which the maggots as they fell from above, or came out from the fallen pears, would adhere to, and thus further mischief be checked.

Where, however, *ground beneath the trees is bare*, probably all trouble of gathering or shaking down might be saved by *skimming* off the surface containing the maggots, or the cocoons in which they turn to chrysalids, which lie from half an inch to two inches below the surface. Small though they are, the maggots and also the silky cocoons are large enough (see figure, p. 63) to be distinguished with the help of a magnifier, especially by one of the orchard superintendents *interested;* and if removed and burnt in the skimmed-off soil any time before the beginning of the following spring, when the Gnat Midges will come out at the time of the appearance of the Pear *blossom-buds*, there does not seem to be any reason for doubting that the plan would act well.

Where orchards are on grass-land the only treatment, excepting shaking down or hand-picking to get rid of the maggots, appears to be poisoning them or preventing their development to chrysalid condition by the application of chemical dressings; choosing, of course, such as are also beneficial as stimulants to plant growth.

Details of the different kinds of dressings found serviceable, and amounts used, have been given in my two preceding Annual Reports; but *usually* the best application to use for dressing appears, both from the published experiments of Prof. J. B. Smith (see note *) and also from our own trials, *to be kainite.* With regard to amount given in an experiment on infested Pear orchard land in New Brunswick, U.S.A., a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton per acre. The result was that in the following year scarcely any of the fruit was found to be infested; whilst in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown, fifty per cent. were "midged," and of the other kind named not one could be found to have escaped.

Nitrate of soda was also found, in the same series of experiments,

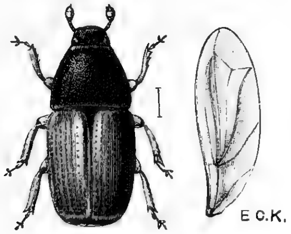
* For valuable observations on this attack, see 'The Pear Midge (*Diplosis pyrivora*, Riley)." Bulletin 99 of New Jersey Agricultural College Experiment Station, April 4th, 1894.

to be useful in killing ninety per cent. of the maggots when sprinkled in quantity which would represent a fair field dressing.

We have evidently, from the reports of the past three seasons, now to look on this Pear attack as a thoroughly established broadscale pest, which, if attended to rightly, and with *co-operation by simultaneous action from neighbouring growers*, may be greatly checked; but which, if *not* looked to, appears, from our experience, to be on the way to establishment as a cause of serious loss.

PLUM.

"**Splint**" or **Sap-wood Beetle.** *Scolytus pruni*, Ratz.



SCOLYTUS PRUNI.—Beetle and wing, magnified; line showing natural length of beetle.

On March 20th in the past season the following observations of what proved to be attack of *Scolytus pruni*, known in Germany as the Splint or Sap-wood Plum Beetle, were sent me from Barton-upon-Humber by Mr. G. W. Mason:—

"Yesterday I was in an orchard here, where the owner showed me a Plum tree which he said was dying. The trunk of the tree was almost completely stripped of its bark where it lay upon the ground. Some of the branches were also being stripped in the same manner. I noticed the tree (together with several others in the vicinity) was perforated with countless little holes. On examination I found a small white larva feeding on the fallen bark. I am sending you a piece of bark with some of the larvæ therein."—(G. W. M.)

Mr. Mason noticed the great similarity of the infestation to that of *Scolytus rugulosus*, or "Wrinkled Fruit-tree Bark Beetle," * which is

* For figures and description of this infestation, see my Annual Report of Observations for 1895, pp. 76–79; also 'Handbook of Insects Injurious to Orchard and Bush Fruits,' pp. 197–201.

also found beneath Plum tree bark (and sometimes in company with *S. pruni*), as well as in decaying Apple, Pear, Cherry, and other trees.

On examining the beetles sent, however, I found that they were certainly specimens of *S. pruni*, which are distinguishable from *rugulosus* by being longer (*pruni* being about a sixth of an inch in length, whilst *rugulosus*, the smallest of our British kinds, is only about the twelfth of an inch); also by the wing-cases being rusty-coloured; and also, and very especially, by the thorax, or fore body, being very finely punctured on the upper part or disc.

Described more in detail, the *S. pruni* beetle varies from rather more than an eighth to a sixth or rather more of an inch in length (3·4–4·5 mm., Eichhoff); the general colour shining black, with the antennæ (horns), which are clubbed, and the greater part of the legs red, or reddish brown (in specimens sent me I found the thighs were of a deep brownish colour). The wing-cases rusty or brown; "the punctured striæ much less strongly impressed, and the punctures of the interstices not much finer than those of the striæ, and arranged in single rows"; and also "the thorax is very finely punctured on disc, and less finely but not very closely at sides, and the ventral segments of the abdomen are simple in both sexes." *

By the above characteristics (with the help of a strong magnifier)—that is to say, by the depth, form, or arrangement of punctures on the fore body—*pruni* may be distinguished from *rugulosus*, of which the thorax is comparatively *coarsely* punctured on the disc (the punctures being elongate), and strongly and more or less confluently punctured at sides, and also the wing-cases are more or less red *towards the tip*.

In the hope of being able to give a precise description of the larvæ of this species, I studied them very carefully, but found nothing in those which I saw differed from the much magnified figure of the larva of *S. rugulosus* (at p. 76 of my Nineteenth Annual Report accompanying observations of *S. rugulosus* given me by Mr. R. Newstead), excepting that the colour of the heads of my specimens accompanying *S. pruni* beetles was paler than that of the figure.

My specimens, which lay in the brown powdery layer of decayed matter beneath the outer coating of bark, were whitish in colour, soft, and legless, and customarily lay with head and tail curved to meet each other, so as to form an arch, or rather a portion of a circle. Head small, *pale yellowish, jaws dark brown;* the segments next to the head inflated, so as to be noticeably larger than the abdominal seg-

* For description, see 'Coleoptera of the British Islands,' by the Rev. Canon Fowler, p. 409.

ments succeeding, which are transversely wrinkled above, and less markedly so below, the upper and under portions being separated by a projecting row of enlargements, or corrugations, at the lower part of each side. The length of the largest specimen when extended was somewhat more than the eighth of an inch from the top of the thorax above the deflexed head to the extremity of the tail; others were about half to two-thirds of this length.

The development to pupal condition in the small amount of infested bark sent me was first noticeable on April 25th. On this date, on examining the larvæ which had been lying in "frass," or powdery decayed matter, just beneath the bark, I found that one had completed the change to pupal state. It was now rather less than one-eighth of an inch in length, and of a palish yellow tint which might be almost described as white. The various limbs folded beneath the body, the wing-cases only reaching to rather more than half the length of the abdomen, and very nearly approximating, but not quite touching, at the bluntly formed tips, and the transverse divisions of the segments of the abdomen showed plainly on the upper surface, excepting near the thorax.

On May 3rd and 4th I found a developed beetle, and also a well-developed pupa, and a beetle with shining black thorax and wing-cases, with punctures arranged in single rows between the striæ, lying in their pupal cells a little within the outside of the bark.

But with regard to the species of *Scolytus*, of which I observed the *larvæ*, much as I wished to ascertain it beyond doubt, I cannot take on myself to say with certainty that they were of *pruni*. The larvæ of *Scolyti* greatly resemble each other, and from the chief presence of *pruni*, and the measurement of the pupa above mentioned, it seems probable that they were of this species. Still *pruni* and *rugulosus* may be found together, and I had the annoyance, after my careful observation, of one *un*mistakable *rugulosus* making its appearance; therefore I give the above descriptions, *certainly being of maggots* of one or other of these "Plum-bark Beetles," and possibly of practical use in connection with further observations.

So far as I am aware, this species is rare in this country; at least I have never before the past season received any report of injury caused by it, nor do I find descriptions of it as being definitely injurious. In continental orchard growing, however, it is recognized as doing much harm. By collating such amount of information as is given regarding this *Scolytus* (= *Eccoptogaster*) *pruni* by the writers referred to below,* it appears that it attacks the large stems as well

* See 'Die Europäischen Borkenkäfer,' von W. Eichhoff, pp. 154, 155; 'Insektenkunde,' von Dr. E. L. Taschenberg, pt. ii. p. 245; 'Pflanzenfeinde,' von J. H. Kaltenbach, p. 154.

as the branches of various kinds of trees, and especially amongst orchard trees of the Plum, Cherry, Apple, and Pear. Here it establishes itself, and breeds between the *bast* and *splint*. That is to say, between the innermost part of the bark, and the outermost part of the wood.

The mother-galleries, or tunnels, are stated to be about eight to twelve centimetres * long, and by this circumstance the workings may be distinguished from those of *Scolytus rugulosus*, of which the mother-galleries are only from one and a half to three centimetres long; and in the very good figure given by Eichhoff of the galleries of *rugulosus*, the mother-gallery is precisely *half an inch in length*. The two kinds frequently breed near together.

The larval galleries (of course) start from the mother-galleries, and it is mentioned by Eichhoff that he has found the attack repeatedly during winter in larval state, and in the month of March in beetle state, though some portion was still to be found in larval and pupal condition.

Breeding-time is in May and June, but development of the beetles is stated to take place some time before.

In the case of the specimens under my own observation, the development to pupa began to be noticeable towards the end of April, and that of the beetles at the beginning of May. The material *beneath* the bark was in too decayed a state (added to it not having been carefully detached) to give specimens of the galleries valuable for record. But as this attack has not previously been reported, I give the above account in the hope of leading some observers to add the points wanted to complete the description of workings.

Preventive measures consist in destroying infested boughs, or bark, so as to ensure attack not spreading on the flight of the beetles.

* One centimetre is equivalent to ten millimetres in length; or, in English measure, two-fifths of an inch.

Mottled Fruit-tree Tortrix Moth. *Penthina* (= *Antithesia*) *variegana*, Hübner.

PENTHINA VARIEGANA, left-hand figure; P. PRUNIANA, right-hand figure. Both figures magnified and natural size.

The following observations refer to the small Tortrix Moth, *Penthina variegana*, Hübner (= *P. cynosbatella*, L.), a species of which the caterpillars have long been known on the Continent as injurious to the leaf- and flower-buds of various orchard trees early in the season. Apple, Plum, Pear, and Cherry are especially mentioned as being subject to attack; and in Stainton's 'Manual of Butterflies and Moths,' vol. ii. p. 194, the moth is recorded "as abundant everywhere." *

But until the past season no observations of its attacks had been sent me, when, in the course of June, specimens of the infestation were forwarded to me by Mr. R. Newstead, Curator of the Grosvenor Museum, Chester, with the mention that he considered the attack very local, but that for some years he had the species under observation, and could testify to its destructiveness. The locality in which he made his observations was within the city boundary of Chester, but he had also received it from Oswestry (Shropshire), where also it was reported to him as being destructive to fruit trees.

The great resemblance of this moth to the nearly allied species, *P. pruniana*, Hb., causes some difficulty in certain identification, more especially when, as in the case of the *P. variegana* = *cynosbatella* specimens sent me by Mr. Newstead, these are not altogether typical; and Mr. Newstead informed me that, after examination by various entomologists, though they appeared to correspond best with *pruniana*, yet he could not absolutely satisfy himself that they were of this species.

Under these circumstances, as I felt personally by no means sure of *pruniana* being the right identification, I laid the matter before

* As the infestation appears to attack all of our common kinds of fruit trees indiscriminately, and there has not this year been a special notice of "Orchard Attacks," I have placed the *Penthina* observations, for various reasons, under the above heading of "Plum."

Mr. O. E. Janson, F.E.S., 44, Great Russell Street, London, W.C., who kindly replied on July 7th :—

"From your sketch and what you describe, I should think your insect is probably *P. cynosbatella* (or *variegana*, as it is now called); but the species of this group are very close and difficult to distinguish from one another. They also vary, which adds to the trouble of making them out without a special knowledge. I will see if I can obtain authentic examples of the two species," &c.—(O. E. J.)

As, however, precise identification was important, I forwarded my two specimens to Mr. Janson, who went into the matter, and also obtained me the authoritative opinion of Mr. Barrett, F.E.S., for which I beg to express my best thanks. Mr. Janson wrote as follows :—

"The *Penthina* arrived safely, and upon examining them we came to the conclusion that they were *cynosbatella* (= *variegana*); but, in order that there might be no doubt, we submitted them to Mr. C. G. Barrett, who confirms our identification. He says: 'Both specimens are certainly *cynosbatella*, yet neither is quite an ordinary specimen, and the upper is of a quite unusual grey tone of colour; *pruniana* has the fore wings shorter and broader, the costa more arched, and the *round* dot wanting.' "*

Of the specimens of *variegana* sent to myself, one was as nearly as possible three-quarters of an inch in expanse of the fore wings, the other not quite so much. They differed slightly also in tint and marking. In each case the basal half or rather more of the wing was brown varied with darker and lighter specks or markings; but in one specimen the ground colour of the anterior portion of the wing was of a pale grey, and in the other of a pale yellowish tint. The tip or extremity of the wing was dark.

In the pale anterior portion of the wing there was (in each moth) a grey spot, a little within the hinder margin; and between this and the front border was a kidney-shaped greyish marking fairly well-defined on the greyish ground, but less so on the yellower tint.—(E. A. O.)

The moth of *P. variegana*, just shortly described, is seven to ten lines in expanse of the fore wings, of which the lower half or rather more is brown or blackish, with black and brown clouds, or spots; the terminal third of the wing paler up to being at times nearly white, partially clouded with grey, and with a spot, as figured (p. 73), the tip of the wing in my specimens greyish. *P. pruniana* is slightly less in expanse of wing, varying from six and a half to eight lines, and so minutely resembles *variegana* in general appearance, that the general description of the basal two-thirds of the fore wing being dark, and

* The figure of *P. pruniana* is added to that of *P. variegana* = *cynosbatella* at p. 73 to show the differences between these two species in size, shape, and markings more clearly than can be conveyed by description.

the apical third white, is given in Stainton's 'Manual' in almost precisely the same words regarding each species. Prof. Westwood mentions *pruniana* having three conspicuous dark dots on the costa (that is, the fore edge of the fore wings); and I find these, as well as some more minute dots, are easily observable with the help of an ordinary magnifier on all my type specimens. But, looking at the variations in colouring of the species, probably the figures at p. 73 will be much more serviceable for practical identification than technical description.*

From such amount of German observations of the life-history of this infestation as I have access to, it appears that the caterpillars are to be found in the clusters of blossom, or leaf-buds, of various kinds of trees, including amongst these Plum, Apple, Cherry, and Pear, where they cause such damage that consequently neither blossom, nor fruit, nor a new growth of shoot is produced, although occasionally a blossom may survive and fruit develop. When young the larvæ only attack the soft leaves or growths at the tip of the shoots, but with increased age they spread to the older leaves near by, and spin them together, continuing their destructive operations within.

Pupation (that is, change to the chrysalis state) is recorded as taking place customarily where the caterpillar fed, and the development of the moths at the end of May and beginning of June.†

The following extracts, taken (with his permission) from Mr. Newstead's fuller records of his personal observations of the habits of this infestation on trees in the city of Chester, correspond well with the above; but it will be seen that they add some useful information regarding habits of the moth after development, and likewise the very important point (which I am not aware of having been previously noted) of the winter habitat of the larva.

Mr. Newstead remarked that the earliest sign of the attack is noticeable in the spring, when the leaves are first formed, and that the habit of the caterpillars is to spin two or more leaves together, or fold over the tip or side of the leaf, and thus form a shelter. The caterpillars are to be found in April and May, and a few in June. It was during the second week in June that the majority of the moths emerged. These were to be found by day sitting on the leaves and shoots with their wings closed, but were easily disturbed; and at night, when they take flight, were readily attracted by artificial light.

* References to the above-named species will be found in the 'Synopsis of Species of British Moths,' by Stephens, in vol. ii. of 'British Moths,' by J. O. Westwood, and in the same volume, pp. 117, 118, will be found descriptions and mention of various of the formerly used generic and specific synonyms.

† See, for above information and references, chiefly 'Die Pflanzenfeinde,' von J. H. Kaltenbach, p. 168.

Later in the year, on Dec. 19th, Mr. Newstead sent me the following further observation of the winter habit of the caterpillar, as he noticed them on Pear:—

"I now find the larvæ of this species hybernates in little tough cocoons attached to the twigs of the Pear tree. They are most beautifully concealed, and it is difficult to find them. I send you herewith one or two examples of the cocoons, which you may find tenanted, but all are not so. On the longest shoot you will find them in four places, indicated by little bits of foreign substances, bits of leaves," . . . . and buds. "I thought they might interest you, and throw some light on the winter treatment of the infested tree."—(R. N.)

On examining the cocoons, I found them (so far as I observed) at or close to the axil of a shoot, and the first I opened contained a caterpillar rather under the eighth of an inch in length, and doubtfully alive, but whether in dying state or drawn up for pupation was not determinable. The colour was of a general dingy green, head shining black, or deep pitchy, and upper part of next segment also shining, but not so deep in colour. Claw-feet dark.

The second specimen was more lively, and with a lighter ground colour, of a yellower tint on about two-thirds of the foremost segments; the three pairs of claw-feet brownish; the four pairs of sucker-feet sufficiently large to be observable when the larva was lying on its side, and about the same colour as the body above. The divisions between the segments well marked; but, from the small size of the caterpillar, the corrugations and rows of tubercles not sufficiently distinct to describe with precision.

Amongst the substances attached to the cocoons, or forming part of the mass, Mr. Newstead drew my attention to the remarkable resemblances that some dark fine filaments bore to human hair. This certainly was the case, especially where all but what might be attached to the cocoon floated free for a length of an inch or so in the air. But, on examining microscopically, with human hair for comparison, as I gathered that some doubt had arisen as to the nature of the threads, the difference was obvious: it was only the largest of the filaments that were the size of human hair; the others varied down to about a quarter or less in diameter, and were not uniformly of one size throughout. Presumably they were threads spun by the larva in forming its cocoon, but with a part of the length, from some cause or other, left floating free.

The only published description of the caterpillar with which I am acquainted is that given in Stainton's 'Manual,' vol. ii. p. 194:—"Larva dull olive green, the spots black, head and second segment black. On Hawthorn, Sloe, &c. Abundant everywhere."

Prevention and Remedies.—For satisfactory application of remedial measures we need information as to details of life-history between the time of the moths (as noted by Mr. Newstead) being observable in June sitting by day (though easily disturbed) on the leafage and in flight at night, and the caterpillars being found spun up in winter cocoons (of manufacture specified) on shoots.

Examination might very likely show that summer damage to fruit-tree leafage, which has hitherto passed unidentified as to its cause, may be owing to these little larvæ, and that presently they pass, as we know is the case with other somewhat similar infestations, from their food ground, or rather leaves, to form winter shelters in a permanent locality.

But as the case stands, the only remedial measure appears to me to lie in heavy spraying with any of the ordinary insecticide washes and poisonous applications; as Paris-green, &c., would act as effectually in getting rid of this as of other orchard caterpillar attacks; but in moth state a soft-soap wash would be a better remedy. The flight of the moths is probably only for a short distance, and those that escaped the spray would be likely to be so injured by the wet sticky soap-wash, which would adhere to them amongst the leafage, that a good proportion might be got rid of.

An excellent note of the good effect of spraying by means of steam apparatus with soft-soap at Toddington will be found in "Short Notices," under the head of "Apple Psylla"; see also Index.

Recipes for preparation of the soft-soap and mineral oil wash known as "kerosine emulsion" have often been given, but the two following formulæ are added to save trouble in reference.

The following recipe is one of the Department of Agriculture of the U.S.A. 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; and this should always be considered, for the same strength may not be safe on all parts of young trees, or on all conditions of leafage.

Another recipe is for "kerosine emulsion" of the ordinary strength for general application; *viz.* kerosine or refined coal oil, 1 pint; common laundry soap, ½ oz.; rain water, ½ pint. The soap was boiled in the water till all was dissolved, then the boiling soapsuds were poured into a watering-pot containing the kerosine, 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.

Pocket or **Bladder Plums.** *Exoascus pruni.*

EXOASCUS PRUNI.—"Pocket Plums," inflated and distorted by fungoid attack. (After Sorauer.)

It has seemed desirable to insert the following observations on the diseased growth popularly known as "Pocket" or "Bladder" Plums, as, although this is due *not* to insect but to *fungoid* infestation, at one time it was considered that the galled growth was of insect origin, and still the nature of the attack is not as well known as could be wished; and it is sometimes the cause of so much loss to the Plum crop, that the history and means of prevention of the infestation should be known.

On July 2nd of the past season, the Rev. E. N. Bloomfield kindly sent me the following preliminary note from Guestling Rectory, in Sussex, which was followed by some more information regarding the appearance of diseased fruit on Damsons, or Plums, at Guestling. Mr. Bloomfield remarked:—

"On Saturday last I had sent to me some enormously swollen Damsons. . . . There were good Damsons on the same twigs somewhat larger than a large pea. The affected Damsons were not only enormously bloated, but utterly *disorganized* and *distorted*, as well as blotched, and no one would possibly have guessed what they were. I should be glad to know if you have met with such specimens, and also whether you can tell me what causes them. I did not cut into any of them, but Mr. Connold informs me that he could find no trace of larvæ in any of those he examined."—(E. N. B.)

Mr. Edw. T. Connold (Honorary General Secretary to the Hastings and St. Leonards Natural History Society) wrote me on the following day (July 3rd) from 7, Magdalen Terrace, St. Leonards-on-Sea, regarding the attack, as follows:—

"At the suggestion of the Rev. E. N. Bloomfield, I am sending you some of the galled fruit of Damson I discovered last week on trees at a farm in Guestling. Can you tell me the cause or maker of them? . . . The swollen fruit herewith is about the largest; none I measured exceeded one and three-quarter inches in length by one and and a quarter inches in girth; very sappy, and when confined from the air a whitish fungus grows rapidly. I have examined many, but have failed to trace any creature upon or within them. Several have shown small round holes, as though a hymenopteron had eaten its way out, but upon dissection the interior was quite clean and free from puparia."—(E. C.)

On July 6th Mr. Bloomfield kindly wrote me again (from Guestling Rectory):—

"As you are not sure whether you have ever chanced to see the diseased Plums, I now send you a few. I find they are at the present time in *all stages* on the trees. The green Plum begins to turn yellow and swells up and gradually becomes darker, still continuing to swell. There were a good many diseased Plums on the trees, but they were not so conspicuous as I had expected; my friend at St. Leonards having sent me the largest specimens."—(E. N. B.)

The specimens sent me varied much both in size and shape, the largest being about one and a half inches long, narrowly oval in shape, and somewhat flattened, and from about half to three-quarters of an inch in width. Others were irregularly mis-shapen growths, mere roundish lumps, not wholly developing the characteristic form, and not advanced beyond from about half to three-quarters of an inch in length, and about half an inch across. In two of these there was some slight amount of growth of kernel, but the healthy young Damsons sent accompanying had already developed a stone of some degree of hardness, with a good healthy kernel within.

The figure, p. 78 (after Sorauer), gives a very fair idea for working purposes of the altered size and shape of infested Plums; one at quite full growth, the other not yet mature. But during December I was indebted to Mr. Connold for a photo of two sprays of Bullace Plum, each with diseased and healthy fruit, which showed the effect of the attack admirably. In one instance especially, a swelled and mis-shapen fruit, figured pendant, with the healthy Bullace only about a third of the length of the deformed fruit pendant at its side, showed the distinctions very perfectly. Should Mr. Connold's photo of the effect of the *E. pruni* fungus be reproduced with any paper which he may give on the subject of the infestation, it would be well worth while for Plum-growers who suspect infestation amongst their fruit to procure a copy, as it shows the kind of mischief caused correctly, and far more plainly than a written description.

Those who wish to study the history of this attack will find an excellent account of it by Prof. H. Marshall Ward, F.R.S., at pp. 107–116 of the little book referred to below.*

The external appearance, and also the internal characteristics of the diseased fruit are excellently and plainly described, as also the nature of the fungoid attack, and the method of its action in altering the development of tissue of the Plum by causing superabundant flow of food-supplies, to the fleshy portion of the fruit, at the expense of those which should have formed the stone and kernel. Notes are given also of measures which cannot fail to lessen amount of presence of the attack.

I extract a few of the main points. It is mentioned that the chief symptom of the infestation consists of the malformed developments which attack the very young fruits as they are beginning to swell, and cause their tissues so to change their natures that, "instead of a ripe luscious Plum with a properly hardened stone containing its seed, we find an unequally formed dirty greenish, or yellow, hollow, and tough

* 'Romance of Science: Diseases of Plants.' By H. Marshall Ward, F.R.S., &c. London: Society for Promoting Christian Knowledge.

body, called a pocket." These young "pockets," when they first begin to develop (in May), are noted as being somewhat elongated, curved, and fairly pliant, "of a yellowish colour, and more or less wrinkled, or grooved. Specimens taken at a later date may be redder, and will probably be covered with a greyish 'bloom,' or powder; later still they will be spotted and rotten with mould. A section of the pocket shows that no 'stone' is developed, and the shrivelled remnant of what would normally have become the seed may be detected in the cavity."

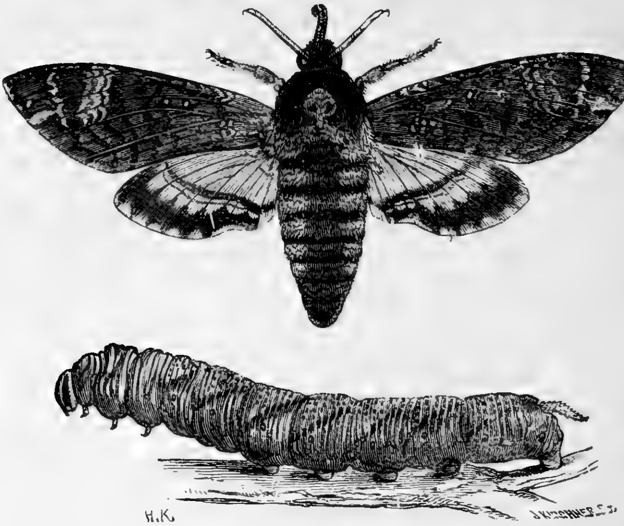
It will be seen by the descriptions at p. 79 of the specimens forwarded me from Guestling, that the characteristics are so excellently observable that all the main points were correctly noted, although the nature of the attack was unknown; therefore I think that, with the help of the short extracts which I have given from Prof. Marshall Ward's authoritative descriptions, there will be no difficulty in recognizing the attack.

One very necessary method of treatment to lessen probability of infestation by means of spread of fungus spores from the diseased fruit is to collect the "pockets" and burn them. But beyond this, as "the fungus is able to carry on its existence from year to year by means of *mycelium* in the branches" (H. M. W.), something further is requisite, and it is recommended to prune back to the old wood.

Where the infestation has got hold, some care in exterminating it would be well worth while; and, looking at the point of the loss it causes, and also that at one time it was ascribed to insect agency, and may often be connected with *succeeding* insect presence, I do not think that I can be wrong in mentioning that, although it is really a fungoid growth, I should be glad of notes of observation and method of prevention to add to orchard notices of the coming season.

POTATO.

Death's-head Moth. *Acherontia atropos*, Linn.



ACHERONTIA ATROPOS.—Moth and caterpillar (not full sized).

The great caterpillars of the Death's-head Moth are amongst the kinds of which some specimens are almost every year sent for identification, but usually these are very few in number. In the past season, however, the various enquiries sent (beginning on August 2nd, and continuing at intervals until October 5th, with specimens of the larva, and later on of the chrysalis, accompanying) showed an unusual prevalence of attack, and much interest was displayed as to the nature and habits of the great grub found in connection with Potatoes, or in turning up Potato land.

As no points of new information were given by the enquirers, it has seemed unnecessary to give a list of the localities written from; but as the appearance of this Potato caterpillar and its habits have proved to be so entirely unknown in so many places, I give the above figure and just a few observations.

The Death's-head Moth—which takes its name from a pale ochrey or orange-coloured marking resembling a painting of skull, or death's head, on the thick black or dark velvety down in the middle of the back—is one of the largest of our British kinds, measuring sometimes from four to five inches in the expanse of the fore wings. These are of a rich brown colour, varied with yellowish and rusty tints, and with black waved or zigzagged lines or cross-bands, and in the middle of each wing is a pale spot.

The hind wings are yellow or orange in colour, with two black or very dark cross-bands, of which the one close to the extremity is usually much wider than the other. The abdomen yellow, with six black bands across, with a line of spots of blue or bluish grey down the centre.

From the great size of the moth and the peculiar marking, com monly known as a "death's-head," in the middle of the back, it is very easily recognizable; but the amount of observation of the species in this stage is very little in comparison with that during its cater-pillar life.

The figure at p. 82 shows the shape and characteristic markings, but does not give a full idea (space not well allowing the figure of a full-sized specimen) of this long thick grub at full growth. My figure only gives the larva at about two and a half inches long, whilst that in the Ray Society volume shows it at about four inches,* and it is recorded as reaching as much as five inches in length.

The colour is yellow, but towards the head and also the lower part of the sides shading into green, with seven stripes slanting from the lowest extremity backwards on each side. The colour of these may be described as blue or lilac or violet, and at the lower part they are bordered by a light or yellowish line. The head is horny, and furnished with strong jaws. The spiracles, or breathing-pores, are black edged with white. The grub is furnished (as figured) with three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair beneath the last segment. Above this pair is a short tail or horn-like process, which is of great service in identifying the species of the caterpillar; this is yellowish, rough or almost tubercled, and bent down, but turned up again at the tip.

The above-mentioned colouring is characteristic of the caterpillar; but there is a rare variety of which I have only seen a specimen (figured on the plate referred to in note), which is of a brown or brownish olive colour, with the side stripes darker, and the fore part of the body whitish.

When full-fed the caterpillar turns to a lurid tint, and goes deep down into the ground, eight inches or more, and there changes to the pupal or chrysalis state, which varies in size, but may be generally described as from about two inches and two-fifths in length to some-what less than three inches; the colour of a rich or dark brown, the head and eyes rather projecting, the segments of the abdomen well marked, and "the tail ends in a large thick flattish rough spike, with

* 'Larvæ of British Butterflies and Moths,' vol. ii. plate xxi.

two *very short* stout spines" (vol. ii. of 'British Butterflies and Moths,' Ray Society, 1886, p. 108).

The common food of the caterpillar is Potato leaves, but sometimes it eats leafage of the jasmine, and also (although I have not myself observed this) it is said at times to feed on the small-flowered shrub sometimes found in cottage gardens, scientifically *Lycium barbarum*.

PREVENTION AND REMEDIES.—With regard to this species remedial measures lie very conveniently for us in our common field or garden operations in raising the Potato crop, *at the same time* so disturbing the operations of the caterpillar in burying itself, or, later on, throwing out the great chrysalis from its hollowed-out pupal cell, more than half a foot deep beneath the surface of the ground, that thus development to moth state of a large proportion of the infestation is prevented. If the caterpillar is disturbed when it is losing power to make its requisite shelter, or the chrysalis is thrown out on the surface, the requisite conditions to development cannot be carried out, and I believe that it is to this simple point of the thorough disturbance of Potato land which takes place in raising the crop that we owe being usually free from anything but a slight amount of presence of this infestation.

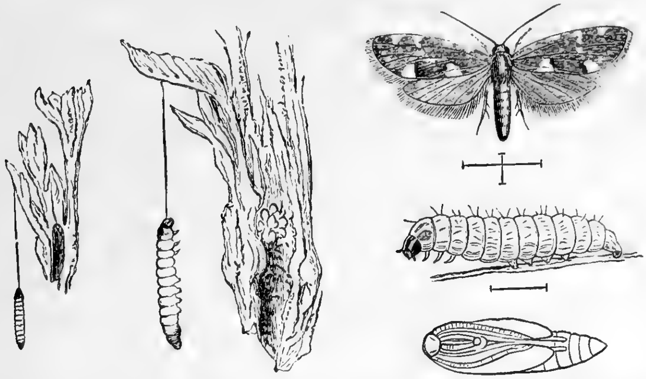
The caterpillar feeds in the evening or at night, and in case any damage worth attending to is found to be occurring to the leafage, it would be well to have examination made at different times to find exactly when these grubs are out at feed, and also whether they are buried in the day-time, where they can be got at, just below the surface of the ground. From their great size they are very noticeable, and in twilight or moonlight they might be fairly easily got rid of by hand-picking.

Gamma or **Silver Y-Moth.** *Plusia gamma*, Linn.

For figure of Silver Y-Moth in different stages, and account of attack to Potato leafage near Holbeach, Lincolnshire, see pp. 53–58. Observations of the outbreak of the caterpillar on Potato, and also on Mustard, along the shore of the Humber, were sent me so precisely at the same time, and with so much co-incident in the circumstances, that it seemed best to notice them together, with references in each case to the other entry.

RASPBERRY.

Raspberry Stem-bud Caterpillar. *Lampronia rubiella*, Bjerk.



LAMPRONIA RUBIELLA.—Moth, magnified, and with lines showing natural size; caterpillars, natural size, and somewhat magnified, from life; caterpillar and chrysalis, greatly magnified, after Prof. J. O. Westwood.

At the end of August of the past season I was favoured by Mr. Alfred Gant, of the Yorkshire College, Leeds, with information of the Raspberry Stem-bud Caterpillar of *Lampronia rubiella* having been causing serious damage in the neighbourhood of Leeds.

The attack is not often mentioned, but sometimes is reported from special localities as causing a great deal of mischief. The first notice sent me of its presence was on May 2nd, 1883, when the late Mr. Jenner Weir, F.E.S., sent me a description of the method of its attack on Raspberries in his garden at Chirbury, Beckenham, and also his identification of the caterpillar as that of *L. rubiella*, which was a valuable contribution, as coming from such a well-known entomologist. In 1891 notes were sent of mischief caused by the caterpillars at various widely-separated localities in England and Scotland; and in 1899 mention was made of the attack being present to some slight degree at two English localities, and of it being a serious trouble to Raspberry growers in the district of Carluke, Co. Lanark, N.B.

The following report, sent on August 31st by Mr. Alfred Gant, of the Yorkshire College, Leeds, shows that in the past season it has appeared in the Leeds neighbourhood to a destructive extent:—

"I should like to bring to your notice that this year there has been a very serious attack of the Raspberry Stem-bud Caterpillar (*Lampronia rubiella*) in Garforth and its neighbourhood close by Leeds. A good many Raspberries are grown in this district for the Leeds market, and an attack of this description entails great loss upon the growers.

"I visited some of the Raspberry plantations in the spring, when the canes appeared as if they had suffered severely from frost, and numbers of the little scarlet maggots were found in the faded shoots. About the first and second week in June I again visited these grounds, and noticed large numbers of the very small moths flying about the canes while they were in flower. The Raspberry canes in this neighbourhood suffer every year, more or less, from these attacks. The usual remedies have been advised. I have also noticed other attacks in other parts of Yorkshire, but none so serious as this."—(A. G.)

The mischievous part of this attack is begun in spring by the little caterpillars which have passed the winter spun up in little round flat white silken cocoons, not much more than the twelfth of an inch in diameter, piercing into the young buds, which are thus sometimes destroyed, or otherwise becomes noticeable by the fading of the young shoots which have been injured, though not wholly destroyed, by the larval attack.

These Raspberry-bud caterpillars are about a quarter of an inch long (for figure, see p. 85), of some shade of red, and with black head and black mark on the next segment, and are furnished with three pairs of black claw-feet, four pairs of sucker-feet, and a fifth pair at the end of the tail. When examined through a magnifying glass, it will be seen that there is a pale line down the centre of the black head, and that the black mark on the next segment is composed of a pair of double spots.

About the end of April the caterpillars may be found in the Raspberry buds—many may be found emerging—and on cutting off buds for examination, many may be found with a burrow from the base to the tip, showing where the caterpillar has been, and many with the caterpillar still inside at the base. Besides these (and which is a very important point practically), many caterpillars may be found crawling on the Raspberry canes. This circumstance of the caterpillars emerging at pleasure to renew attacks on other buds near has been noticed by several special observers.

As the attack advances, the *young shoots* fail from the mischief caused by the presence of the caterpillar, and (as mentioned in the communication given above) have almost the appearance of being frost bitten; and at this stage nothing can be done to check the then present ravage, excepting, of course, breaking off the shoot and destroying it if the caterpillar is still within. (I have had a note or two of the caterpillar eating its way into the cane itself, but I have never myself seen examples of this method of attack.)

About May 18th the caterpillars may be found beginning to spin up in the buds and change to chrysalis state. A specimen sent me spun up in web in the bud was tawny, or reddish yellow, on as much of the back, from the head onwards, as was visible. The wings were folded beneath it, and were yellowish; the abdomen was of a full pink. The moth is to be seen in June. This is a very small creature. The expanse of the wings is a little under half an inch; the head ochrey grey, with yellowish face. The fore wings shiny, with a brown ground marked with yellow dots and spots, of which two are very noticeable on the hinder edge, and there are four smaller spots on the *costa* or fore edge. The hinder wings brown with paler fringes.

The above information was, I believe, all that was definitely known of the life-history until the important points as to where the moths lay their eggs, and where the young caterpillars feed, and how they shelter for the winter, was observed and recorded in 1891 by Dr. T. A. Chapman, of Hereford. These are given in full in the paper referred to below,* and extracts also, duly acknowledged, in my notice of *L. rubiella* at p. 94 of my Annual Report for 1891, and p. 209 of my 'Insects Injurious to Orchard and Bush Fruits'; therefore just a few words of the main points of this part of the history are sufficient here.

Dr. Chapman observed that the egg of *L. rubiella* is laid when the Raspberry is in blossom, the moth selecting an open flower, and the egg being inserted just beneath the surface of the "receptacle"—that is, of the central part of the flower which afterwards grows into the conical white portion on which the Raspberry fruit is placed. Here (in this fleshy white receptacle), when the Raspberry fruit is ripe, the *L. rubiella*, or Stem-bud Caterpillar, is to be found ready to quit it. This may either be done by simply coming out and crawling away, or by boring a way out at the base of the foot-stalk of the fruit, and the caterpillar then spins itself a little white cocoon (as described at p. 86), by preference apparently at the stool of the plant, from whence it comes out in the spring to begin the attack we know only too well.

Prevention and Remedies.—No notes have yet been given of any attempts at winter or spring treatment, when the infestation is lying in quiet state in cocoon, or subsequently appearing on the canes. But it would appear worth while to try the effect of throwing dressings of ashes, or sand, or dry earth, mixed with paraffin, well amongst the stools. In the proportion of one quart of the paraffin oil to one bushel of the dry material, the application did no harm at all to the young shoots of seven hundred Hop plants coming up through it in experimental treatment relatively to prevention of Hop Aphides. It might well be hoped that the presence of the application might do

* See "The Oviposition and Autumnal Larvæ of *Lampronia rubiella*," by Dr. T. A. Chapman, in the 'Entomologists' Magazine' for June, 1891, p. 169.

some good in killing the caterpillar during winter in the cocoon. Any way, it seems to me worth while to try the effect.

In the latter part of the winter, or early spring, good drenchings by means of ordinary or steam sprayers with kerosine emulsion, or some one of its soft-soap equivalents or substitutes, just at the time when the red caterpillars are setting out from their cocoons to attack the buds, or subsequently wandering on the canes from one bud to another, would certainly be likely to be beneficial.

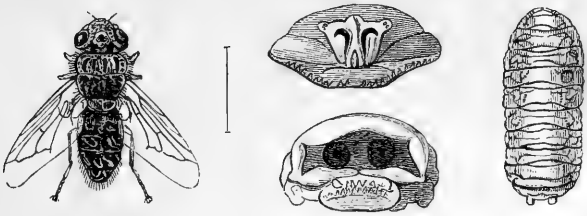
The only remedial measure which I have notes of at present as having been employed is the plan of breaking off the infested buds or little shoots, and destroying them. This cannot fail to be of use in preventing recurrence of some amount of the attack where care is taken that the broken-off fragments are so treated that the caterpillars within cannot get away to turn to chrysalids in any appropriate shelter they may crawl to.

The shoots, or buds, should be dropped as cut into pails of any mixture preferred, such as would prevent the infestation creeping away; or, if cut into baskets, these should have a metal (or some kind of) lining which would prevent the caterpillars getting away through openings between the willows, and also a good rubbing of paraffin and soap mixture round the top to prevent egress of the pests over the edge.

Some knowledge of practicable method of coping with this attack is greatly needed, for now reports are sent of it as doing a deal of mischief in various localities where there are extensive Raspberry grounds. Any serviceable results from syringing when the moths are about are not to be hoped for, as they lay their eggs in the open blossom; but some experiments in regard to prevention when the attack is still in caterpillar state might teach a great deal, and be of general benefit.

SHEEP.

Maggot of **Sheep's Nostril Fly.** *Œstrus ovis*, Linn.



Œstrus ovis.—Fly, magnified, line showing natural length; maggot; mouth hooks of maggot; and tail segment, showing spiracles, and lobes, acting as organs of progression—all magnified. After Brauer.

The attack of the Sheep's Nostril Fly is becoming much better understood than it was formerly, both with regard to its life-history and as to methods of prevention; but still, from enquiries sent, the infestation is evidently not as well known as is desirable. In itself it may be easily recognized, and preventive measures may also be easily applied, but complications arise from it being sometimes confused with the brain disease known as the "Gid," or staggers, which arises from quite a different cause; sometimes also observation of a chance presence of the maggots, when they have from some special circumstances strayed down into the throat, leads to enquiry as to what the attack can be.

I have never had many enquiries about it in any one year, but for more than fourteen years information has been asked from time to time, and last season the following enquiry was sent me, with specimens accompanying, on June 27th, from near Horncastle, in Lincolnshire *:—

"The enclosed grubs were taken out of a Sheep's head at the top of the nostrils, as near the brain as we imagine they could get; six in number; when taken out, all alive. The Sheep's head was purchased from a local butcher, so I am not able to say anything about the appearance of the Sheep. I shall be much obliged if you will give me your advice, and what they are, and what damage they do to the Sheep if not disturbed, and where and how they get worked up the nostrils."

The specimens sent showed the attack to be of Sheep's Nostril Maggot. When full-grown these grubs are about an inch in length, and about a third of an inch in width, but, from their powers of

* I do not give my correspondent's name, as this is not always wished.

contraction, vary in apparent size; the back very convex, or arched, the under surface somewhat flat, and the general shape of a long oval; or, rather, the sides parallel, with the head end prolonged, and the tail end blunt. The colour at this stage has gradually become yellowish, and on the back of each segment, excepting on the first and last, is a transverse dark streak. Beneath, on the abdomen, are rows of spines, all pointing backwards, which assist the grub in moving.

The head end is furnished with two well-defined dark brown hooks, and between them is a little hollow, which answers the purposes of a mouth (see figure, p. 89). The last segment of the tail extremity is truncated upwards (see figure) with a circular margin projecting *over* the dark breathing-pores, and a kind of lip *below* bearing small spines.

The method of attack is for the Sheep's Nostril Fly to deposit its living larva (or maggot) at or just within the opening of the Sheep's nostrils, from which it begins at once to make its way upwards to the inside of the nostrils by means of its head-hooks and its spines. At this first stage of growth the maggot is a very little thing, only about (or less) than a twelfth of an inch in length, legless, as it is throughout its life, the shape elongated, and the skin white and transparent; but little of the structure can be made out without the help of a magnifying glass, unless it may be the little head-hooks (see figure, p. 89). The colour gradually alters with age of grub up to maturity, as mentioned above.

After starting in young state on its journey inside the Sheep's nostril, the maggot progresses upwards by fixing its two hooks in the mucous membrane inside the nostril, and thus it is enabled to hold fast and draw the rest of the body after it, and then, pressing on the abdominal spines (mentioned above), which all *point backwards*, it by this means keeps itself in place whilst it loosens the head-hooks and reaches this part forwards to take a new hold. But this method of progression is not altogether harmless to the Sheep, as it is recorded:—"If one may judge from the black dots, indicating a previous hæmorrhage, scattered over the mucous membrane, the irritation set up by the wandering embryos is very considerable." *

As the maggots grow, they make their way into the recesses and furthest chambers of the nose; in some cases finding their way when still small into situations from which, when at a larger size, they cannot escape, and consequently perishing there.

When full-grown, if all has gone on in regular course, the maggots loose hold of their hooks on the mucous membrane, and drop to the ground; sometimes are expelled by being sneezed out. From the the middle of April to the end of July is the time noticed as the most

* 'Animal Parasites of the Sheep.' By Cooper Curtice, D.V.S., M.D. U.S. Dept. of Agriculture, Washington, U.S.A. 1890.

special season for the maggots to leave the nostrils; but they may be found at other times, and maggots of all ages, it is stated, may be found in the winter time. Amongst inquiries sent me about this attack forwarded on May 12th, one, in 1889, was accompanied by six maggots of different sizes up to five-eighths of an inch long, taken from one sheep.

They are stated by various writers to remain for about ten months in the nose cavities, but this is not absolutely proved.

After the maggot has escaped from the nostrils and fallen to the ground, it bores into it for an inch or two, and there contracts and changes to a *puparium*, or chrysalis-case, smooth and hard, and of a dark colour, within which the fly develops, and from which it emerges, according to various observers, at very different lengths of time—some giving *three or four weeks*, some *more than twice that time*, as the period of development, according to state of weather.

The Sheep's Nostril Fly (*Œstrus ovis*) is from about two-fifths to half an inch in length, and slightly hairy. The upper part of the head and body between the wings of some shade of grey or dull yellow, spotted or mottled with dark markings. The abdomen yellowish, or white, mottled with dark brown or black; the under side similarly coloured, but "with a dark spot in the middle of each ring." Legs brown or yellowish brown; wings transparent, and when at rest extend beyond the body. Mouth wanting. There is a good deal of difference in the exact shades of colour described by various writers; from such as I have myself examined I should say that the fly might be described as spotted, or mottled, with ash-grey, and black between the wings, and the abdomen also spotted with black and yellowish white, with a silvery lustre when alive.

This attack is considered not to be serious, excepting in occasional instances, as where there may be an unusual number of maggots, yet the symptoms recorded as accompanying even a common amount of maggot presence show a degree of annoyance to the sheep that is much better avoided. The discharge from the nose, the throwing the head upwards and shaking it, and the sneezing and snorting, all show great uneasiness. Sometimes there is a good deal of trouble, amounting in severe cases to difficulty of breathing from stoppages occasioned by presence of the maggots, or inflammation of the mucous membrane; but, excepting (as above mentioned) where there are many maggots, the attack does not appear to be often fatal, and when the cause of the trouble has been got rid of in natural course the sheep recovers.

I do not remember having had information sent me of more than six larvæ being present together in any case of nostril infestation reported; and in Dr. Cooper Curtice's paper, previously quoted,* he

* For reference to title, see *ante*, footnote, p. 90.

says:—"Rarely have more than six or seven been found. Cases have been reported in other countries where far larger numbers, as many as ten to fifteen, were found. . . . The presence of all sizes of larvæ in the cavities is a plain contradiction to the statements that the fly appears only in June and July, for no matter whether it takes ten months for the larvæ to grow or not, young and middle-sized and mature larvæ found in the winter time could not all have been laid within the two months indicated."—(Dr. Cooper Curtice, *op. cit.* p. 31.)

The presence of the Nostril Fly amongst the flock may be known by the sheep holding their noses close to the ground, shaking their heads, and striking the ground violently with their fore feet. Sometimes gathering together with their heads in the centre and their noses down to the ground, or buried in dust or sand if there is any, and occasionally one sheep going off at a gallop as if to escape from an enemy.

In regard to localities in which the maggot may be found, the idea which at one time was prevalent, that it is to be found in the brain itself, has been entirely *disproved* by modern writers. In the earlier enquiries sent to myself previous to the year 1887, the specimens accompanying were noted from time to time as having been found "in the brain," or "at the base of the brain," as the case might be.

This supposed presence in the brain has long been proved to be an impossibility, for proof of which the reader is referred to anatomical details given in the publications of modern veterinary writers; but with regard to the presence of the grub in the gullet, or elsewhere, from accidental circumstances, the observation of this chancing to happen during its very temporary occasional occurrence, sometimes gives rise to a deal of perplexity.

On May 12th in the past season the following communication was sent me from near Tamworth, with specimens of *Œ. ovis* larvæ of different sizes, the largest five-eighths of an inch long:—

"I am sending you herewith specimens of grubs apparently in the windpipe of sheep, and shall be much obliged if you will give me your advice as to their nature, and if any cure can be effected.

"My young sheep have been doing very badly ever since they were weaned last year, and during the winter I lost as many as twenty of them. Yesterday we had them penned for washing, and one accidentally got smothered. I dressed it, and upon opening the head found as many as six of the enclosed grubs. I shall be much obliged for any information you can give me about them."

In this case there is evidence of the maggots being present in what is called in a general way the head (presumably the usual locality of the nostrils); and as transit from the nostrils can take place by means of the passages communicating with the back of the mouth, it may be supposed such was the case. Also the presence of the maggots in the windpipe may have had something to do with the smothering in washing.

The power of rapid movement in these maggots when advanced in growth is very remarkable. In my own observations I have found that it would be as quickly as from three and a half to four and a half inches in a minute when the maggot was placed on a cloth. When placed on the hand I found, both by feeling and sight, that it helped itself on by fixing its black mouth-hooks into the skin with a firm pressure, and with its tail apparatus it propelled the body forward, thus alternately dragging and pushing itself onward.

There seems no reason to doubt the possibility of the maggots being sometimes found in localities accessible from the nostrils; but, at the same time, in some instances they may simply have fallen there quite accidentally in the operation of cutting up the sheep.

One special sign of the presence of the maggot in an advanced stage of the attack is a catarrhal discharge from the nose, which is stated to be at first "clear and serous, then thick and mucous. Frequently there is sneezing and snorting; . . . from time to time they stagger and are seized with vertigo, but do *not* turn in a circle. In severer cases there is difficulty of breathing, the first respiratory passages being obstructed by the larvæ or the inflammation of the mucous membrane" (C. C.).

The fact of the nostril maggot-infested sheep *not turning in a circle* is one very important point whereby to distinguish this attack from the so-called "Gid," or staggers, produced by presence of the hydatid *Cœnurus cerebralis* (the early state of the Tapeworm of the Dog), in which the affected sheep *does* turn, but has *not* the symptoms of nasal discharge, or snorting.

Prevention and Remedies.—These do not come within my own personal observation. In case fumigations or nasal injections should be thought desirable (although benefit from their application appears a very hopeless matter), these would require veterinary assistance. Recipes and methods of application will be found in veterinary publications.

Where maggot presence is found only on one side of the nose, an operation is sometimes performed called trephining. An opening is made with an instrument called a trephine into the *frontal sinus* (one of the passages to which the maggots can creep from the lower part of the nostrils), and through this opening *some of the maggots may be observable*, and may be picked out with forceps, and to kill others benzine diluted with water has been used. But beyond all doubt, whatever vague *possibilities* there may be of success, the points should be considered, regarding which warning is given, in regard to the various branches of application of this stringent treatment. The operation is tedious, requires some skill, and should only be performed by a veterinary surgeon; also the ultimate results are not such as to make the operation what can be generally advised; and also the effect may be only temporary, as, even if the maggots then present have been satisfactorily removed, others may creep on and take their places.

For available and serviceable treatment "a practical means of prevention consists in smearing the noses with a mixture of equal parts of tar and grease, or of tar and fish oil, or of tar and whale oil. The better way is to apply the preparation directly by a brush. Some recommend smearing the salt and grain troughs with the mixture, expecting the sheep while feeding to get more or less on the nose. This method is not thorough enough. Fish or whale oil alone is also recommended."

The following ointment is advised:—

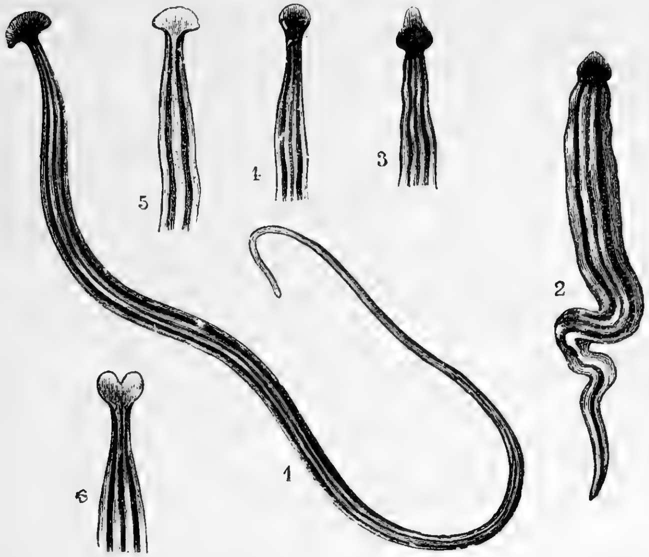
"Beeswax, one pound; linseed oil, one pint; carbolic acid, four ounces. Melt the wax and oil together, adding two ounces of rosin to give body, then, as it is cooling, stir in the carbolic acid. This should be rubbed over the face and nose once in two or three days during July and August.

"All grubs seen on the ground should be crushed. Heads of slaughtered sheep should be cared for so that mature grubs cannot escape to the ground. Sheep-yards should be periodically cleaned and sprinkled with lime."

Those who wish to go into history and treatment of the attack in detail will find information in Dr. Curtice's work, previously referred to (pp. 25–34, with three plates); also in 'Treatise on Parasites and Parasitic Diseases,' by Prof. L. G. Neumann, translated by Dr. Geo. Fleming, pp. 568–573; in which publications will also be found information on *Cœnurus cerebralis*, of which the attack is sometimes confused with that of *Œstrus ovis;* also in my 'Flies Injurious to Stock' I have given a short paper on the Sheep's Nostril Fly.

WORMS. (PLANARIAN.)

"Flatworm"; "Land Planarian." *Bipalium kewense.*



Bipalium kewense.—1, extended; 2, contracted; 3, 4, and 5, different forms taken by the head—all life size. (After figures by Prof. F. Jeffrey Bell). 6, bifid form of head, rather larger than life.

On May 20th, 1900, a specimen of the very peculiar looking creature figured above was sent me by one of our leading horticultural firms, requesting information regarding the nature of the specimen. On investigation, and also with the aid of technical assistance afforded me, I found the somewhat worm-like and bifid-headed creature to be *Bipalium kewense*, and consequently to belong to the Geoplanidæ, or "Land Planarians," a division of the *Planariadæ*, which is one of the families into which the class of *Vermes*, or Worms, is subdivided.

Therefore, as they may be correctly described by the word "Worms," which conveys some sort of an idea of their appearance, I have this year placed them under the above name, as at heading, with the distinctive appellation of "Planarian" added.

These creatures—that is, the Geoplanidæ, or Land Planarians—are characterised by their long and flattened body, which is furnished with a foot-like ventral surface. Fig. 1 shows the *Bipalium* elongated into its worm-like shape; fig. 2, contracted and widened so as to somewhat resemble a long Slug. The colouring, as shown in my specimen, was of a kind of livid grey, with three darker longitudinal stripes starting from behind the head, and the head itself was of the bifid form figured at "6"; but, whilst I had the specimen under observation, I did not notice any alteration in the form of the head.

One extraordinary characteristic of this species of "Flatworm" is the power it possesses of altering the shape of the head. The fullest observations of which I have knowledge are of those of Prof. F. Jeffrey Bell, referred to below*; and in these he particularly directs attention to the variability of the form of the head, so that, whilst the "cheese-cutter" or hammer-shaped heads (see figs. 1 and 5, p. 95) are very commonly known forms, there may be other shapes—as knob-like, tongue-like, or altogether irregular. Of these and other forms, Prof. Bell gave a series of figures in the plate accompanying his paper, and it seems to me to be of great interest that not only should there be a difference in the shape of the head under different conditions, but that, *as personally observed by Prof. Bell*, the head of a single specimen should vary considerably and almost constantly in form, and *it is from the changes* of one specimen that the figures given are represented.

In regard to the specimen which came under my own observation, which was forwarded to me in moss from a hothouse or some similar locality, I saw nothing at first excepting a sort of slimy-looking streak. By way of possibly rousing whatever the thing might be to a more lively condition, I placed the moss in some very slightly warmed water, and the effect was rapid. The creature became evidently alive, and gathered itself together into the shape of what might be described as a small snake with a bifid head, but much shorter than fig. 1, p. 95; and, apparently not finding its quarters comfortable, set out almost immediately on a journey up the sides of the bowl in which the moss was placed, carrying its bifid head steadily before it, and by means of its flattened under surface making very solid though slow progress.

Being then wholly unacquainted with the nature and habits of what to my thinking was a very repulsive-looking creature, I fastened it up again in its box, and, after gathering what information I could about it, published this in my Annual Report for 1900, pp. 111–113. At the time, this was little more than that this "Planarian" was sometimes found (even for many years, if once established) in hot-houses, and that it had a great power of secreting slime, so that minute objects causing annoyance could be thrown off "in a continuous sheet of mucus."

* See "Note of *Bipalium kewense* and the generic characters of Land Planarians," by Prof. F. Jeffrey Bell, M.A., Sec. R.M.S., in 'Proceedings' of the Zoological Society of London, 1886, pt. ii. pp. 166–168. Figures 1–5, at p. 95, are copied from plate accompanying the above-mentioned "note," excepting that the position of fig. 1 is altered to adapt it to space.

I did not find any observations of this "Flatworm," *B. kewense*, being injurious to plant life; but, as besides the fact of this "exotic worm" being found, as mentioned above, in hothouses, it was also noticed as found amongst broken pots, and on one occasion as having been at the bottom of a flower-pot "which had been in a cold frame all winter," I gave a short account of the infestation, with the suggestion that some further information would be very desirable.

This I was kindly favoured with in the course of the past season by Dr. R. Stewart MacDougall, Entomologist to the Royal Botanic Society of Edinburgh, in the following communication, sent me from the Royal Botanic Gardens, Edinburgh, on April 4th, in the past season (1900). In this, it will be seen, some points of much interest are entered on—the method of its introduction into this country; its habits as especially feeding on Earthworms, and the manner in which its sticky secretion helps it to secure and conquer its prey. Also the method in which multiplication of the *Bipalium* is believed to be carried on in this country. Dr. MacDougall wrote me as follows:—

"I noticed your mention of *Bipalium kewense*. This tropical form of Land Planarian has been introduced in plants and soil from somewhere or other to our country and also to Germany. I know it quite well at the garden here in the tropical house, and have often watched it, whilst there is at least one record of its having been found in the open near Edinburgh, as chronicled by Professor J. Arthur Thomson. I showed several specimens of it two years ago at a meeting of the Botanical Society of Edinburgh.

"In food habits the Land Planariæ seem to be chiefly, if not entirely, carnivorous, and the worm in question, *Bipalium*, preys on Earthworms, which it seizes and holds on to by means of the sticky secretion from glands along its ventral surface. They can hold on very tightly. I have seen a little *Bipalium* tackle a plump Earthworm three or four times its own length, and, though the Earthworm did its best, it was quite unable to shake off its enemy.

"Lehnert reports that *Bipalium*, having fastened itself to the caught worm, proceeds to extend its pharynx over the front part of the Earthworm, whose tissues are sucked into the alimentary canal of the *Bipalium*. I have never seen this, but have noticed the Earthworms seized, generally at the anterior end, and then sucked by their foe. The Earthworm, when let go, would be in a jelly or broken in two.

"It is believed that, living in our country, *Bipalium* can only multiply itself vegetatively by breaking up into several pieces, each of which proceeds to grow on the necessary parts to make it again a complete worm."—(R. S. MacD.)

I have much pleasure in being permitted to insert the above communication, as giving us definite information from a practical, as well as scientific observer, as to the nature of the food of these Bipaliums. Possibly, now that attention has been directed to their habits, more information may be added. But, meanwhile, we have gained the information that this species may be as useful in checking an over prevalence of Earthworms in the localities where circumstances allow it to live in this country, as the Snail-slug,* *Testacella haliotidea*, Draparnaud, is in reducing the amount of presence of Earthworms (which it is quite possible to have too many of) out of doors.

* See my Twenty-third Annual Report, pp. 126–131.

SHORT NOTICES.

In my Twenty-third Annual Report (that is, the first part of my Second Series of Observations of Injurious Insects) I varied from the original plan of arrangement by giving under a special heading of "Short Notices" such disconnected observations of appearance, habits, treatment, or remedial measures relatively to insects previously referred to (with so much repetition of description of the attack as was necessary to show what was referred to), as conveyed useful information in addition to that of the detailed and illustrated observations given in the previous series of twenty-two Annual Reports.

In this manner the points of new information contributed up to date are preserved, possibly to complete the accounts of the various infestations in a future publication; and meanwhile repetitions *un*necessary to the customary recipients of the Annual Reports are avoided. To others who may wish to study the history of any special attack, the information is made available by means of the references at the end of each of the following papers, and also by the General Index, for which see advertisements.

APPLE.

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

The attacks of this minute insect have hitherto been found very difficult to deal with satisfactorily; but in December, in 1900, Mr. C. D. Wise wrote me from the Toddington Orchard Company's Fruit-grounds, Winchcombe, R.S.O., Glos., that they had had great success in clearing this pest from its harbouring places in the trusses of the Apple blossom by powerful application of soft-soap wash. Mr. Wise wrote as follows:—

"Apple Psylla.—We were successful in spraying for this pest with the soft-soap wash last spring. With our steam spraying apparatus we are able to drive the wash *down into the trusses*, both before the blossom is open and after the fruit is set. The steam spraying apparatus to which I refer is made by Messrs. Merryweather."—(C. D. W.)

These little insects are hardly the eighth of an inch long, and from the four wings with which they are furnished being transparent, they are hardly distinguishable by the naked eye. Through a magnifying glass it will be seen that they are usually of a beautiful bright green colour; the abdomen is pointed; the head has long hair-like antennæ, or horns, furnished at the ends with two minute *setæ*, or bristles; and the eyes are sometimes white, with a central black spot, which gives them the appearance of having a pupil.

In autumn, when the Apple leaves are beginning to turn yellow, the insects are more easily observable, as they may then be found in parties of half-a-dozen or so on a leaf, and are then (at this time of pairing) very varied in colour. Some may be of one colour—green, or red, or white; others may be variously marked with green and yellow, or green and red, or yellowish with a red or brown tint along the top of the insect from head to tail.

After pairing the females leave the foliage, and lay their eggs, which are commonly of a white spindle-shape, on various parts of the tree, sometimes in hollows near the end of shoots, sometimes on year-old shoots where there is fine hair. From these eggs the young Apple-suckers hatch in the following April. These little "Chermes," which, like their parents, have six legs, and much resemble them in shape, excepting in being wingless, are of a dirty yellowish colour, with brown abdomen. But (as mentioned before) even the fully-developed "Chermes" being hardly an eighth of an inch long, the distinctions of these little larvæ are not discernible by the naked eye. Their *presence*, however, is indicated by the presence of small opaque little balls, or globules, about the stalks of unopened flower-buds; and if the cluster be pulled open, the young wingless insect will be found in numbers sucking the juices of the stems of the blossom.

The young Chermes has the remarkable power of being able to exude a white transparent tubercle (attached by a whitish thread) from the extremity of the body, and if this is removed it can eject another ball and thread. On the second moult it ejects a ball with a thicker thread, and also a great number of fine entangled threads, or small hairs, with which it entirely covers its head and body.

Later on it turns to the pupal state, for which it fixes itself firmly; the skin splits, and from it the winged Chermes steps out (in about four weeks' time from the laying of the egg), and may appear from the beginning of May to the beginning of June.

The mischief caused by the *Psylla* is especially by the young insects driving their suckers into the stems of the blossom-buds, and drawing away the juices, thus sapping their strength, so that the buds shrivel before expansion, and no Apples are produced.

Various methods of dealing with the attack have been suggested, but none have been brought forward of such a serviceable nature as this of the soft-soap spraying lately contributed (see p. 99) by Mr. Wise. This is especially adapted to the peculiar habits of the Chermes of working amongst the stalks of the cluster of Apple buds, sometimes especially amongst those of the middle blooms of the truss, where they cause complete destruction.

Of course, the broadscale application of steam spraying apparatus is only available in a very moderate proportion of cases; but now that we have such trustworthy information of the serviceableness of the remedy, it is much to be desired that, as circumstances require, it should be applied as by horse or hand-sprayers when presence of the "Apple-suckers" is noticed.

For observations on the above attack, see my Annual Reports for 1890 and 1891, and 'Handbook of Orchard and Bush Fruits.'

GOOSEBERRY.

Gooseberry and Currant Sawfly. *Nematus ribesii*, Cameron.

Attack of Gooseberry Sawfly is mentioned again, as in the past season the caterpillars appeared in extraordinary numbers in the neighbourhood of Tarporley, Cheshire, and many thousands of them were cleared by hand-picking.

The caterpillars are distinguishable from those of the Gooseberry and Currant or Magpie Moth (which are almost equally destructive to leafage) by being green, with black heads, and little black spots on their bodies when young, and when full grown they are an inch long, and green, with the segment next the head and a little of the next one orange-coloured, as are also the tail segments, but with a *large* black mark above, with smaller dots at the side; also by possessing, besides a pair of black claw-feet on each of the segments next the head, six pairs of sucker-feet beneath the body, and another pair beneath the tail, making twenty pairs in all.

By the above characteristics they may be easily known from the caterpillars of the Gooseberry Moth, *Abraxas grossulariata*, which are usually of a creamy or yellowish colour, with a row of transverse squarish black or dark markings along the back, other lines of little or larger black spots below; along the sides of the caterpillars and beneath the two highest of these rows of spots is an *orange or red stripe.*

Other markings are observable, and also varieties of marking, even up to the caterpillar being entirely black; but by the above-mentioned differences in colour of the two kinds of caterpillars, those of the moth and sawfly may be distinguished from each other without further description.

In regard to those of the sawfly, of which such numbers appeared last year near Tarporley, the life-history is that when full-fed they go down into the ground, where they turn to chrysalids in brownish or yellow-brown cocoons, from which the sawfly may come out in summer in about three weeks' time; or, in the case of the late broods, will appear in the following spring, when the Gooseberry and Currant bushes are coming into leaf.

The flies are four-winged; the wings transparent and iridescent, and about half an inch or rather more in expanse. The colour of the flies is yellowish; the body between the wings with some large black marks in the female, in the male almost entirely black; abdomen yellow or orange in the male, the back of abdomen black excepting tip.

The customary methods of dealing with this troublesome infestation have been given at great length in my Annual Reports, and in reasonably abridged form in my Handbook of fruit pests, pp. 101–108 (title given preceding at p. 101); but on June 4th of the past season I was kindly favoured by Mr. William Bailey, Head Master of the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, with the following observation of the great number in which the caterpillars had appeared, and also the great number which had been collected by the pupils at the school, where attention is constantly given to serviceable *practical* study of habits of common insect pests, and means of reducing their numbers :—

"This year we have quite a plague of the Gooseberry and Currant Sawfly caterpillars. The numbers collected and brought to school by the boys in the three lower classes in the school on Wednesday, Thursday, and Friday in last week totalled no fewer than 9765. The boys in the upper part of the school handed in 5072 of these grubs."—(W. B.)

Returns were also given of the numbers of other kinds of destructive caterpillars collected by the boys.

But with regard to the sawfly caterpillars. Besides the immediate good effect of lessening presence of this bad insect pest by the large number named, amounting collectively to 14,837, I have just noticed the subject, as (at the present time when so much is being said about drawing attention to natural history in rural districts) this gives an example of what may be really done in a locality of no great area, and in short time, also without expense, and with full approval of all concerned, towards clearing away farm and garden pests, and at the same time adding very usefully to the knowledge of the boys. I have personally and for many years been fully acquainted and co-operated with the working of the whole system of which the above is but one small detail, and can say that it answers excellently.

PEAS.

Cabbage Moth. *Mamestra brassicæ*, Linn.

The Cabbage Moth is one of our very common insects, and its caterpillars well known for the damage which they cause (and sometimes to a very serious extent) to various kinds of Cabbage—as summer Cabbage, Cauliflower, and the like. Besides their especial fondness for the Brassicaceous crops (from which this species is named), they feed, according to convenience, if nothing more to their taste occurs, on almost any other ordinary plant leafage; but it was not until the past season that I had a trustworthy notice of the caterpillars doing such definite injury to the shoots and leafage of Pea plants in a garden under observation, and for two successive summers, that it seems worth record, and this more especially as, from the difference in colour of the grubs in very early life, from their subsequent well-known appearance, they are not always easily recognizable.

In their quite early stages they are green, but afterwards the body is usually divided longitudinally into two equal regions as regards colour; the upper half as a general thing being of olive-brown ground colour, the lower ochreous. The tints, however, vary exceedingly. Sometimes the upper part is brown instead of olive, sometimes black with flesh-coloured markings, and sometimes the entire body has a ground colour of a dingy green. The length of the caterpillar is about an inch and a quarter. The head is ochreous, or marbled with darker brown, and on the back of each segment is a somewhat triangular-shaped mark, lighter at the edge and pointing backwards. The caterpillars are cylindrical, smooth, but somewhat velvety, and roll into a ring if annoyed. When full-grown they leave their food-plant, and change to chestnut-coloured chrysalids in the earth, or on the surface of the ground, from which the moths come out in May, or later in the following summer.

These moths are about an inch and two-thirds or rather more in expanse of the fore wings, which are of a rich brown or dark smoky grey-brown mottled and marbled with confused markings, some paler and some black, with a ear-shaped spot bordered with white. The hinder wings are brown, paler towards the base, and the head, body between the wings and abdomen of the same colour as the wings.

On July 23rd, Mr. W. Sim, of Gourdas, Fyvie, Aberdeenshire, wrote me enquiring regarding the nature of an infestation, of which he sent me quite young larvæ (lepidopterous), and also specimens of the extent of damage done to the Garden Pea, which he mentioned as being similar to what had occurred in the previous year (1900), which was considerable. Mr. Sim observed:—

"The caterpillars, which are bright green at first, begin to feed on the top of the young Pea plants before the leaves and blossoms are unrolled, and as they feed and grow for a considerable time, the destruction is nearly complete. Sometimes there is only one caterpillar on the plant, but there are often three and four or even more. These caterpillars grow darker at each moult, and when full-fed they are not at all like the same thing, and are not very desirable; they bury in the ground, and become unprotected chrysalis before winter. The chrysalis works its way to the surface a short time before the moth emerges the following summer."

On examining Mr. Sim's specimens on the 24th, I found almost all of them to be rather more than half an inch long when extended; the general colour of the caterpillars green; palish apple-green in the youngest specimens, darker in the older larvæ, with five *fine* longitudinal white lines. The three uppermost (that is, the central line and that on each side), when carefully examined with a two-inch-focus glass, I found to be chiefly formed of *small* white spots or little marks. The lowest line on each side running along the line of spiracles was broader and continuous. Head very pale. Sixteen-footed; feet much the colour of the body immediately above; caudal prolegs well developed.

From the circumstance of the infestation being noted as feeding on Pea leafage certainly in two successive years, and also as I was unable to find any description that coincided, the only course seemed to be for me to feed the specimens and see what happened. They ate broken Pea-pods with the contained Peas, as well as Pea-tops.

On the 29th—that is, five days after I had received the specimens —I found that they had now changed in colour, or were changing to a variously marked brown above the spiracles, and yellow-green below, and in other respects were become, or becoming, so like the caterpillars of the very common Cabbage Moth, *Mamestra brassicæ*, that, on the 31st, I added a piece of Cabbage leaf to their food supplies, and found that they ate it quite as freely and hungrily as the Pea leaves.

From their rapid growth the longest specimen now measured about an inch and a half in length, and was apparently about to change to chrysalis state, and there was now no reason to doubt that the larva was that of *M. brassicæ*, which view was further confirmed by Mr. Sim sending me specimens of the moth, which he had himself bred from these Pea-eating larvæ, which proved to be those of *M. brassicæ*.

In most of the technical descriptions of this larva to which I have had opportunity to refer, the early colouring is mentioned (that is, if it is noticed at all) as being of some shade of green, but I do not find any details of markings given any more than of the very special and continuous selection of Pea leafage for its food. Therefore, as I have long known Mr. Sim to be a careful observer, I have given the above notes as (I believe) an addition to what is commonly accessible regarding the habits of this very great pest.

For a remedial measure in this case, probably nothing would act better than hand-picking from the Pea plants ; as a general treatment, turning the chrysalids out to the surface of the ground where they have buried themselves, so that they may be cleared by birds, or be killed by being thrown out of their self-made shelters, is a good plan, and is still more effectual if (in case the labour is worth while) the chrysalids are hand-picked from the ground and destroyed.

This kind of attack is not often enquired about, but some short notes regarding it are given in my Annual Reports for 1880, 1881, and 1882. Also at pp. 28–31 of my 'Manual' the life-history is given, with means of prevention and remedy, especially for attack to Cabbage, the crop chiefly subject to its attacks.

PINE.

Pine-shoot Tortrix Moth. *Retinia buoliana*, W. V.

The attack of this species of *Retinia* to Pine shoots is stated to be common and generally distributed in Britain ; but I have only once before received enquiries regarding the infestation, and on one other occasion the presence of this species was alluded to by one of my correspondents as occurring near King's Lynn, in Norfolk.

In this case Mr. E. A. Atmore, F.E.S., mentioned that the little moth *R. buoliana* caused much injury to Scotch Firs in the neighbourhood by rendering the shoots sterile, and that the allied species, namely, *R. pinivorana*, *R. pinicolana*, and *R. turionana*, also caused some little mischief in a similar manner to that of *R. buoliana* in Scotch Fir.

In the only instance in which I received specimens of the infestation, a parcel of Scotch Fir shoots, with insects accompanying, were sent me by Mr. R. Gough, Forester to the Duke of Bedford, from the Woods Department, Park Farm Office, Woburn, Bedfordshire. This was early in June, 1895, and from the good supply of characteristically distorted shoots sent, then containing caterpillars and chrysalids and the moths, some of which developed before July 19th, and in good succession afterwards, I was able to make a thorough investigation of the attack.

The main points of the infestation and its effects are that the little reddish moths appear towards the end of June, or in July, and in the dusk of the evening they swarm about the tops of the Pine trees which they infest, and are said to be mostly found on trees of from ten to fourteen years old. After pairing, the females lay their eggs singly between the buds at the end of the shoot; caterpillars hatch from these eggs towards the later part of summer; these are of a dirty brown colour, with head and next ring black; and from the gnawings of these grubs a flow of rosin results, which to some degree coats over the injured bud. Here the caterpillars pass the winter, and in spring they often attack the *neighbouring shoots or one side of them, especially under the shelter of the resinous exudation and the spun web.*

The result of the attack is (in one form) the growth of a number of *small* more or less deformed shoots taking the place of what should have been the leader either of the tree or of the affected bough, and thus giving a "besom-like" bunch of shoots round the destroyed bud. Or it may be that the injured shoots assume a distinctly *elbowed growth.* They may very likely not be killed, and the shoots may turn up again and grow on in the right direction, but an angle—a kind of step, so to say—will have been established, and the stem consequently be crooked.

From this very peculiar form of growth, the name of "Post Horn" attack is given to the infestation in Germany. The presence of the mischief is noticeable not only from the distorted growth of the shoots, or the superabundance of small weak shoots taking the place of what should have been one, or a very few strongly developed growths, but also by the unhealthy and stunted state of the leaves on the part of shoot above the locality of the injury. Sometimes the part above the caterpillar-workings was covered with brown or pale *completely stunted leaves,* or with scales representing them; that is to say, buds containing the leaves which had not freed themselves from their sheaths, and which lay completely clothing the shoot (like tiles on a roof), each scale little more, in most cases, than about a quarter of an inch in length, and to the number of about one hundred on about two inches length of shoot. The stunted growth might vary in degree: on one shoot, for instance, the leaves being about half an inch long at the lower part, and gradually becoming smaller and more closely pressed together, until towards the end of the shoot they were mere short scale-like growths, almost flatly pressed one on the other.

The chrysalis state to which most of the caterpillars sent me early in June had turned (in the bundle of shoots sent me from Woburn) lasts for four weeks. The moth is a very pretty little insect, rather less than an inch in the spread of the fore wings, which are of various shades of yellow, or rich red, or reddish orange, marked with lines and stripes and spots of shining silvery colour; hinder wings blackish grey, but with some amount of yellowish tinge.

In the past season the following letter from Mr. J. Marriott regarding what proved to be attack of *R. buoliana* to Scotch Fir on the property of Lord Braye, Stanford-on-Avon, Rugby, was forwarded to me as a possibly interesting addition to former contributions on the subject of this attack by Mr. R. Newstead, Curator of the Grosvenor Museum, Chester. Mr. Marriott wrote on July 2nd of the past season :—

"I am sending a tin containing bits of Scotch Fir twigs that have been attacked by a grub, and these bits contain, each of them, the said grub. The twig attacked does no more good, and the tree has to put out another twig, maybe a leader, thus spoiling the growth of the tree, and losing several months' growth. We cut these specimens out of one particular 'spinney,' where the grub is at work among scores, perhaps hundreds, of the trees. I thought it would be interesting at least to know something of the history of the creature. We have had some damage of this kind before, but not noticed so much as in this particular 'spinney.'"—(J. M.)

This insect does not wholly confine its attacks to Scotch Fir or Black Austrian Pine, but appears to prefer these kinds.

Prevention and Remedies.—It is said that treatment such as is best adapted to ensure a healthy start and vigorous growth of the trees, and also not allowing overcrowding, are good preventive measures, but it is very certain that the remedial measures which are suggested by the conditions of the attacked shoots cannot fail to do good.

Where the buds are seen, as described at p. 106, to be coated with the resinous exudation and web, which shows the presence of the caterpillars within, these should be broken or cut off and burnt. The caterpillars are to be found, according to good German authority, from September until May of the following year between buds of the Fir, and later on *in the young shoots*, and they turn to chrysalis state at the spot where they ceased to feed. Therefore, cutting off the buds in the early stage of the attack, or, later on, cutting off the parts of the new growth which show signs of attack, and burning these, is an absolutely certain method of getting rid of a deal of nursery of future mischief.

If there is any doubt as to whether the caterpillar or chrysalis is still present, the simple test of opening a dozen or so of shoots in infested plantations would at once show the stage of development.

But probably something might be done as a preventive measure by means of *spraying*. One characteristic of the attack is that (chiefly in July) the females rest by day amongst the Pine leafage, but *in the dusk of the evening they swarm about the tops of the trees.* In all reasonable probability good sprayings with some mixture of soft-soap with an addition of paraffin or some mineral oil, as of "Anti-pest," for instance (see Index), whether applied by day or in the evening, would do a deal of good. In some cases knapsack sprayers would act well, and where there was space for passage of horse or steam sprayers these would meet any difficulty as to throwing applications to any height required.

For previous reference to this attack, see my Annual Report for 1895, pp. 72–76, with figure of moth, and also of distorted shoots and stunted leafage.

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