







West, Newman photo

TURNIP

(about a quarter of life-size) affected by disease known as
ANBURY; FINGER-and-TOE; or CLUB;
caused by SLIME FUNGUS (*Plasmodiophora brassicæ*).

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REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1892,

WITH METHODS OF

PREVENTION AND REMEDY.

SIXTEENTH REPORT.

BY

ELEANOR A. ORMEROD, F. R. MET. SOC., & C.

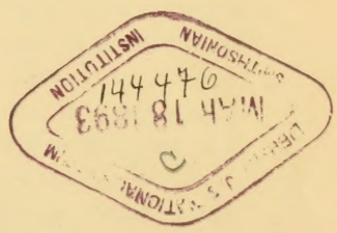
LATE CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND;
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PREFACE.

THE year 1892 was remarkable for most of the insect infestations commonly injurious to field crops and fruit, being present to such an extent as to cause enquiry as to their nature and methods of prevention, but, for the most part, as not affecting large districts to a serious extent.

Amongst such crop attacks as were more especially prevalent and injurious, were those of the leaf-eating Pea Weevils, of which the detailed reports show amount of damage up to the sweeping off of successive sowings; and, over areas of various extent, up to serious mischief over a district of 1000 acres. The caterpillars of the very common Silver-Y Moth caused unusual damage in various places to Clover; and the Hop Strig Maggot was again mischievous. Mangold crops in many places had (as has been repeatedly the case of late years) again to bear the brunt of sharp attack of Leaf Maggot. Corn Aphis (so far as information sent in showed) was the most injurious corn insect attack of the season. Diamond-back Moth presence was widely noticed, and in some localities (perhaps most of all on the north-easterly parts of Norfolk, and near St. Andrew's, in Scotland) as being observable in great numbers; but compared to the outbreak of 1891 little caterpillar attack followed, so that serious damage only occurred locally, not as a widespread scourge. Various kinds of root attacks to Turnips and Cabbage (duly entered on) also caused trouble.

Some kinds of crop infestation were brought under notice which have hitherto been little, if at all, observed as injurious in this country. Amongst these is a species of moth caterpillar,* which, where present at all, entirely destroys the infested stems of Potato by tunnelling up the centre. Also the maggots of a weevil beetle, hitherto not reported as a crop pest in this country, which was found in large numbers within Cabbage stems in one district in Ireland. The Yellow-legged or Dutch Clover Weevil

* The scientific names of the insects are given with the notices of their attacks.

occurred as doing mischief to Clover leafage which is worth record, as the damage caused to the leaves by these minute "Pear-shaped" Weevils is not so often noticed as that to the seed.

In the case of the Frit Fly, of which the maggots sometimes cause serious loss by feeding in young Oat plants in the spring, we secured specimens of the late brood in the Oat-heads in harvest time, thus completing the year's history of the infestation, which is always desirable. Amongst Mangolds we traced a root attack on the young plants, to presence of a minute, but exceedingly numerous beetle and its maggot, which it would be very useful to have further observations of in the coming season.

Mustard Beetle attack being now taken into consideration for observation and experiment by growers well acquainted with all the requirements of the subject, will probably be put on a much better footing.

In connection with Turnip and Cabbage-root insect attack, I have so often received enquiries as to the nature of the diseased enlarged growths, commonly known as "Anbury," "Finger-and-Toe," or "Club," that, as I have personally studied this infestation and its cure for years, it seemed desirable to give some notes on this "Slime Fungus" attack, together with those on insect attack, often coincident with it, though of quite a different nature. To this paper three Plates are added, after photographs from life, to afford investigators the opportunity of observing the minute alterations which take place in external structure as well as in form of the diseased roots.

Under the head of Tomato will be found an account of the appearance in this country of the attack of the *Heterodera radicicola*, the "Root-knot" Eelworm, so-called from the galls to which its presence gives rise. It is to be hoped that in this country it will not spread to the roots of many kinds of out-of-doors fruit and vegetable crops, as is the case in America. Still the infestation is so destructive, also so very infectious, and so exceedingly difficult to extirpate when once established, that it is a serious matter for consideration by growers of fruit crops under glass.

Amongst ordinary fruit attacks, of which the histories have been serviceably added to, are the Currant-shoot Moth, observed by Dr. Chapman, of Hereford; and further information on Apple Sawfly, through co-operation of Mr. Coleman, of Cranfield, Newport Pagnell. The large amount of enquiry regarding common

fruit and forestry attacks it is unnecessary to particularize, but amongst the latter there was a serious instance of attack of the Alder Clearwing Moth caterpillars in one locality (see first paper in following report), which, as far as I am aware, is the first recorded instance of serious damage from this infestation in this country.

Besides enquiry as to home crop infestations, there has also been an unusual amount of application from British residents in the Colonies regarding infestations on Colonial crop produce, as Sugar and Cocoa in the West Indies, Tea in the East Indies, Oranges in various places; and also regarding English or European attacks, of which the presence has spread, or been specially noticeable elsewhere, amongst which the destructive Flour Mill Moth, *Ephestia kühniella*, has unfortunately a foremost place; and other infestations of various kinds, especially to Vines, have been brought under notice. To these, in some cases, I was able to attend from personal knowledge, in others (where requisite), I availed myself of skilled assistance.

From the observations sent in from agriculturists and fruit-growers, it will be seen that serviceable and well-founded attention to measures for prevention of insect ravage are steadily increasing. The observations from the Toddington Fruit Grounds are an excellent example of this advance. In some cases, doubtless, serviceable information is being also afforded by the new system of rural lecturing on "Economic Entomology"; but in some, I think, I am almost bound to say, as I am so frequently honoured by being referred to by our agriculturists, that I think they would do wisely to weigh the advice given before acting on it.

We have amongst our lecturers men skilled in the various branches required, good entomologists, and also possessed of the requisite agricultural knowledge and *experience* to apply this serviceably; but, in some cases, the two latter items are so totally wanting that I have the evidence in my hands that to follow the advice given would have been ruinous or impossible. Probably in these cases a year's study on a farm, so as to allow a knowledge to be acquired of action of manures, effects of different methods of ploughing, and of different kinds of implements, of various actions of chemical dressings in various circumstances, and of the ordinary treatment and rotation of crops, as well as the important consideration that details of cultivation which

may act well as insect preventives in some circumstances, may be totally inapplicable in others, and many other points well known to an agriculturist, would make an enormous change in the views of the young teacher. Any (correct) information as to habits of insect life is serviceable, and would be gladly welcomed by us all. But crude theories of treatment pressed on us by those who have no *experience* of how far they are applicable, need correction from those whose losses might otherwise be counted by hundreds of pounds.

Reverting now to the present subject, I have once again to offer my cordial thanks to the many friends, both British and foreign, who have aided and co-operated with me in the past year. To myself, as well as to us all, the skilled assistance of leading entomologists has been very valuable, and on the co-operation of our agriculturists, and on their kindness (which I always gratefully acknowledge) in placing in my hands reports of insect presence, and details of treatment which *they find serviceable and practicable at a paying rate*, depends the chief use of my yearly Reports. To our agricultural, and often to our general, press I am also greatly indebted for their encouragement and courteous help.

A few words should be added on the loss which we all have suffered in the recent decease of Prof. J. O. Westwood, Life-President of the Entomological Society, who has lately been taken from us full of years, honoured for his goodness and uprightness, as well as for his vast and sound learning, and regretted by all who knew him. As Hope Professor of Zoology in the University of Oxford, he continued the course of his instructions until within the last few months of his life, and as an entomologist he stood perhaps unrivalled. But few at the present day are fully aware of the great services he rendered to agriculturists and fruit growers by his careful observations of injurious insects and measures of prevention and remedy, and his sound working out of the principles of insect classification and rules of life. As the colleague and pupil, which he honoured me by calling me, I add my tribute of respect to the memory of my good leader, and always kind helper in my work.

Once again, in placing the results of the past year's work in the hands of my contributors, with thanks for their co-operation, I ask their co-operation also for the future. Although my health, and especially the long and severe suffering consequent

on an accident to one knee, made it desirable for me to resign my official post of Entomologist to the Royal Agricultural Society of England, I trust in no way to lessen amount of careful attention to any enquiries sent me regarding insect pests injurious to farm crops or fruit growing. It would be a pleasure to me to attend to the best of my power.

In the following Report, I beg to acknowledge with thanks that of the 37 wood engravings given:—13 are used by kind permission of Messrs. Blackie & Co., Glasgow; 3 (namely, figures of moths at pp. 104, 116, and 118) by permission of Messrs. Allen & Co.; and 1, p. 67 (of the Magpie Moth), is from figures of which use was granted at commencement of these Reports by the Editor of the 'Gardeners' Chronicle.' In all other instances I trust that, save where the figures are drawn especially for my own publications, the source will be found to be acknowledged accompanying. The four Plates are after photos from life, taken for this Report.

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Late Consulting Entomologist of the Royal Agricultural Society of England.

TORRINGTON HOUSE, ST. ALBANS,
February, 1893.

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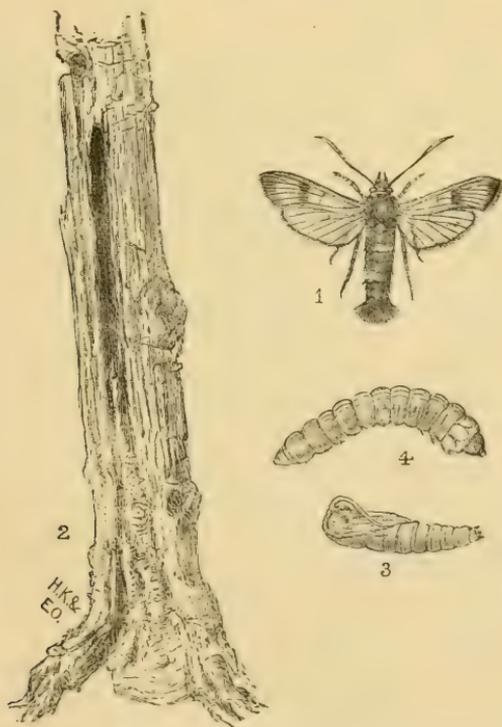
NOTE.—In the above list of papers, that on Red Spider is not placed under the heading of any special crop, on account of it being such a very general infestation. The various Turnip and Cabbage-root attacks are noticed together for convenience of parallel consideration of conditions,

NOTES OF OBSERVATIONS
 OF
 INJURIOUS INSECTS
 AND
 COMMON CROP PESTS.

DURING 1892.

ALDER.

Alder or "White-barred" Clearwing Moth. *Trochilium sphæ-
 giforme*, Westwood.



TROCHILIUM SPHÆGIFORME.

1, Clearwing Moth; 2, infested Alder-stem; 3, chrysalis: all from life; 4, caterpillar (caterpillar copied from fig. 1, plate xxviii. of vol. ii. of 'Larvæ of British Butterflies and Moths,' by W. Buckler, published by the Ray Society).

THE attack of the Alder Clearwing has long been known on the Continent as injurious both to Alder and Birch; but with us the appearance even of the moth has been recorded, in our standard works, as seldom being observed; and (so far as I am aware) until the past season no observations of the method of attack have been taken here, nor has it previously been noticed as occurring to an injurious extent.

In Stephens' 'British Entomology,' this Clearwing is mentioned as an insect so decidedly rare that the writer had only seen five indigenous specimens; and Prof. J. O. Westwood notes that "it is very rare in this country."* In Stainton's 'Manual,' vol. i, p. 100, it is observed that this species (*T. sphægiforme*) is at large towards the middle or end of May, and in June; but that "being so great a rarity," he cannot give directions where it may be found; and with regard to the habitat, he merely mentions (p. 105), "Lives in stems of Alder."

When, however, it does effect a settlement, the instance of last season shows that it has such a power of causing mischief here, as well as on the Continent, by means of its caterpillars boring up young Alder stems, that it is quite qualified to hold a place amongst our seriously injurious insects.

I had not myself ever received any observations regarding this "Alder," or "White-barred" Clearwing Moth, until the beginning of May in the past season, when I was favoured with the first of a series of communications by Lieut.-Gen. Sir J. Hills-Johnes, V.C., K.C.B., of Dolacothy, Llanwrda, S. Wales, regarding mischief caused by this attack in one of his Alder plantations, together with specimens of the infested stems containing the chrysalis, from which I was able to rear the moth (as figured at heading).

In the first observation, received about the 2nd of May, it was mentioned, "The young Alders were planted two years ago, and looked very healthy last year till close to the end of the season, when they began to droop, and my woodman found this grub just where the tree issued from the ground" (J. H.-J.); and on the 6th of May further specimens of the young Alder, then being destroyed by the attack, were forwarded, the grub being then alive within.

In such of the points as were then observable, the method of injury agreed with that described by Dr. Bernard Altum † as occurring in the case of Continental attack, as follows.—"This *Sesia* lives by preference, whilst in larval state, in young Alder stems; but it infests the Birch also. It is to be found in June (the time of flight) near these trees, hovering low down, or on the foliage. They appear not to be rare anywhere in our country." The life-history is thus described:—"They lay a single egg, deep down, at the root-knots of

* See Humphrey and Westwood's 'British Moths,' vol. i. p. 140.

† 'Forst Zoologie von Dr. Bernard Altum, Insecten,' ii. p. 41.

little Alder stems of only about three centimetres in diameter. In the first summer the caterpillar *ravages** these beneath the bark; it hibernates; and in the second summer gradually makes its way upwards by a straight feeding-gallery.”—(B. A.)

The above account gives an excellent description of the condition of the Alder stems sent me. These were upwards of half-an-inch across, and where the attack had run its course for two seasons, the stem was deeply gnawed at the base beneath the bark so as to ring it, or destroy it still more deeply. From this injured base the grub-channel started straight up the stem. This tunnel was from three to four inches in length, and from an eighth to a quarter of an inch in breadth, and took a straight, or only slightly deviating, direction upwards, until at the highest extremity it curved to one side and opened out in the side of the Alder stem (see fig. p. 1), giving the exit-hole for the future moth.

In some cases a disaster appears to occur to the growing caterpillar, for, in one specimen stem, the tunnel had been successfully worked out up to the commencement of the curve for the opening aperture, but there operations had stopped, and the deceased tenant, now dried up, though still showing a strong, horny, chestnut-coloured head, and darker jaws and front of face, was lying shrivelled within.

The large quantity of “frass” (that is, of brownish powdery matter resulting from the caterpillar feeding in the wood) was very noticeable. This filled up much of the lower part of the upright tunnel figured (p. 1), and was observable amongst the ravages at the base of the stem. It was also observable at the base of one stem, where, presumably, as yet only one summer’s injuries had been carried on, as the wood just beneath the bark had been channelled and gnawed round; but the upright tunnel had not yet been started.

The method of infestation was described shortly, but with all requisite clearness, from his own local observations, by Sir J. Hills-Johnes. The attack is started by egg-laying at the root, at the junction of the stem and ground; and the caterpillar in due time turning into the chrysalis condition, appears as a fly, emerging from a hole up in the stem. The observer noted that occasionally two tunnels were to be found in one stem.

The first specimen seen in the act of emergence by Sir J. Hills-Johnes was observed on the 3rd of June; the specimen figured at p. 1 was observed by myself on the 6th of the same month as recently emerged from the chrysalis sent from Dolacothy.

* The German word “platz” expresses vehement action, as, to crush, crack, burst, or, in popular application, “to observe no medium”; therefore I have thought that the word “*ravage*” would convey the absolute destruction wrought by the caterpillar, and well shown by the specimens sent to me.—E. A. O.

This emergence is stated by Dr. Bernard Altum to take place in the second (not the following) year after the egg is laid. After having eaten its way up to the top of the tunnel, the caterpillar hibernates for the second time, then turns to the pupal or chrysalis state; and at the beginning of the summer the pupa is stated to push itself out of the "flight-hole," and the moth escapes. The transverse rows of prickles or points on the abdominal segments, by means of which the pupæ are able to push themselves through the opening of the larval tunnel, were clearly observable in the specimen sent with the help of a moderately strong magnifier. The colour of the pupa was a medium shade of brown.

The moth (see figure, p. 1) is only about an inch in spread of the fore wings, which are transparent, at least towards the base, and the hinder wings are also transparent, whence the name of "Clearwing." The moth is generally of a blue-black colour; the horns, or antennæ, have a whitish or yellowish ring or bar on the upper side; the *thorax* (or body between the wings) has a lateral yellow line, and the breast has a yellow patch; the abdomen has *one* white or yellow ring, and possibly a spot or bar at the base. The tuft at the end of the tail is fan-shaped and black. "The fore wings have the margins and transverse mark and tip, blue or brown-black" (J. O. W.). Hind wings, with fringes purplish black. On the first examination of the specimen figured, when it was presumably only recently developed from the chrysalis, the full lemon-yellow, rather than white, tint of the markings was very observable; in about a day or so, however, this colour had become much paler in some of the markings, and the point may be worth noting in reference to identification.

The following description of the larva or caterpillar is taken from 'The Larvæ of British Butterflies and Moths,' by the late William Buckler (London, published by the Ray Society, vol. ii. p. 49).

As there were no caterpillars, in a condition for description, present in the Alder stem when received, I give the following note, by Mr. Buckler,* of "a full-grown larva of this species, which he had found burrowing in the stem of the Alder tree." "The larva was about an inch in length; its flattened head was of a purplish red-brown colour; the second segment, which was very much larger than any other, bore a shining plate outlined with brown; there was also a shining ochreous plate on the anal segment. The body was of a pale yellowish flesh-colour, with the dorsal vessel indistinctly seen through the semi-transparent skin. The spiracles were brown, but not very distinctly visible, and there were a few short fine hairs in the usual situations."—(W. B.)

* See vol. previously quoted, p. 49.

PREVENTION AND REMEDIES.—The failing appearance of the infested Alder stems is one sign that mischief is going forward. The attacked stems are stated by Dr. Altum (in paper previously quoted) gradually to fail, wither at the top, grow water shoots, and at last perish. In the case of the infestation at Dolacothy, it was by the drooping of the young Alders that attention was called to the injury that was going forward, and the grub was found working at ground level. By these workings, and the starting of the bark that covers them, the attack may be known in its early stage; and afterwards by the aperture for escape of the moth, or by the chrysalis sticking out of this aperture, being observable a few inches up the stem.

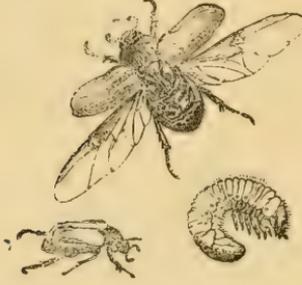
Timely felling of the infested Alders, and also destruction of the undergrowth of stems, are measures specially recommended; but probably, to be effective, an overlooker's superintendence would be needed. To make sure work, the Alders should be cut below the ground level, where the caterpillar works in its early stage. If the stem is merely cut carelessly through, it is a chance, but sufficient length may be left above the ground level for the caterpillar to carry out the rest of its life in. Also, *as soon as* the Alder stems are cut they should be sawed through, just above the flight hole, or about six or eight inches above the ground level, and the short sawed-off pieces thrown at once into a box, or tub, or some vessel, and presently burnt. Thus all risk is done away with of the development of the moth from the infested stems, which would be exceedingly likely to happen if the Alder stems were simply laid aside as cut.

Where leisure does not serve to clear an infested plantation, it might be worth while, whilst the attack is still only at ground level, to try the effect of some dressing. Even if the mischief was so far advanced that the stem was past saving, still killing the caterpillar would save spread of attack, and, where taken in good time, the grub might be killed and the stem saved. For this purpose a solution of soft-soap with paraffin, or some Paris-green mixed in it, might very likely answer well.

As a preventive of attack (where there was reason to fear infestation), it would probably answer to throw some ashes, or sand, or dry earth sprinkled with paraffin, round each Alder stem, at ground level, in June, or when the moths are about. This application, at a strength of one quart of paraffin oil to one bushel of ashes or dry material, has been found, when used as a dressing on Hop-hills, not to cause any injury to the tender shoots pushing up through it, and would probably act well as a deterrent to egg-laying of the Clearwing at the base of the Alder stem.

APPLE.

Garden Chafer; May-bug; Rose Beetle. *Phyllopertha horticola*,
Linn.; *Anisoplia horticola*, Curtis.



PHYLLOPERTHA HORTICOLA.

Beetle, nat. size (walking), magnified (flying); grub, also magnified.

The attack of the Garden Chafer, so far as is shown by comparison of reports of recent and of long by-gone days, appears to be one of the few crop infestations which are less observable now than formerly.

In 1844 John Curtis drew attention to these Chafers being "so great a plague" in two of their stages, that it was desirable to give an account of their life-history, and in various papers he gave dates of great appearances.* The earliest noted was in 1814, "in immense numbers," near Swansea. In 1832 Apple and Nectarine trees were very seriously injured; in 1833 Roses were especially noticed as attacked; young Apple trees are noticed as being occasionally defoliated by them, and at another time (of which I have not the date; but prior to 1844) the Chafers are noted by Curtis as being "so abundant on the Acacias, near Petersfield, as to consume the foliage, and when the trees were shaken, they fell down like a shower of hail."

In his 'Farm Insects' (Edition of 1860), Curtis mentions the beetles as abundant every year, and well known in every part of the kingdom, and to be found in May and June on hedge-rows, &c.; but that it is in maggot state in which the infestation is most destructive, and "although they are mischievous in gardens, it is in pasture-lands and lawns that they commit the greatest ravages," by consuming the roots. 1839 and 1840 are mentioned as years in which the maggots were especially abundant in autumn in Hants and Gloucestershire, and this great presence of maggots happened also in 1844 in different localities; but since 1877, the date of commencement of this series

* See 'Gardeners' Chronicle,' vol. iv, p. 700; Curtis, 'Farm Insects,' pp. 219—222, and p. 509; also Curtis, 'Brit. Ent.,' fol. 526.

of reports, I am only aware of one note of the appearance of this Chafer to any remarkable amount having been sent me. This was at a locality near Northwich in Cheshire, where it was noted on the 18th of June, 1885, that the beetles were flying in thousands over the fields, and were also on the ground in great numbers; also that they appeared "to be emerging from holes in the soil": a few days later the beetles had so far disappeared that they were not to be seen in any great numbers together. It was specially remarked that grubs resembling Cockchafer grubs had been observed in the same field in the previous year "when ploughing up the grass-sod for corn, so no doubt "they had then been feeding at the Grass roots."*

Since then I have heard little about this infestation until the past season, when the beetles were noticed in large numbers on various kinds of orchard fruit trees in the neighbourhood of Haslemere in Surrey, and the following note of damage at Grass roots caused by the Chafer maggot, in a locality where infestation of the Apple trees by the parent Chafer beetles had been noticed in the preceding June, was sent me on the 19th of September, by Mr. Wm. Jenkins, from The Willows, Abergavenny, Mon. :—

"I send herewith a few specimens of grubs which are doing much damage to the Grass in my orchard, and in a meadow which is near. The parts that are attacked are quite yellow, and the surface of the turf comes off easily, revealing the grubs in great abundance." . . . "They seem to me to resemble the grub of the Field or Garden Chafer, which you depict at p. 381 of your 'Manual.'

"I would mention that on the 15th of June, the Apple trees in the orchard referred to were much infested by a small Chafer, called here the 'Button Fly.' Great numbers were caught by shaking them down on to a sheet spread under the trees, but many escaped by flying away." . . . "I find that the pest exists in some fields adjoining my own farm, and the starlings are very busy at work there at present. I hope they will visit my farm soon; meantime the fowls are doing what they can to find out the grubs, though it is a difficult task for them. I do not remember such a visitation before." . . .

On examination of the specimens forwarded, I found them to be the maggots of the Garden Chafer (figured at p. 6). These are very like Cockchafer grubs in appearance, but much smaller; whitish and fleshy, with a chestnut or ochreous-coloured head, furnished with rusty-coloured jaws, darker at the tips, and the hinder extremity of the body somewhat swelled, and appearing to be of a lead colour from the contained food showing through the skin. The grubs, for the most part, lie curved head and tail together, but they are furnished with a longish

* See 'Report on Injurious Insects for 1885' (Ninth Report), by Ed., p. 28.

pair of legs on each of the three segments next to the head, and can walk or drag themselves along at pleasure. The specimens sent me moved fairly rapidly.

The method of life is for the eggs to be laid in the ground, where the maggots hatch, and feed on the roots of (apparently) any kind of plant. Their favourite working-ground is at the roots of Grass in pastures; but they also attack roots of various kinds of corn, and Clover; amongst garden crops they do not except various kinds of Cabbage; and amongst harder rooted plants they are injurious to Rose roots, and have even been found at Pine roots. Formerly it was thought that they lived (or might live) for three years in maggot state, but from more recent observations it is considered that they do not live thus for quite a whole year. They are stated to lie usually about an inch below the surface, but when autumn cold comes on, or when they are about to change to pupal condition, to go deeper. The pupa or chrysalis is pale colour, and formed in an earth-cell.

The beetles are of the size of that figured in act of walking at page 6. The head and fore body are of a glossy bright or dark green, "sometimes with a violet tinge"; under side and legs greenish black, and wing-cases bright chestnut; the horns rusty or chestnut coloured, terminating in a three-leaved club or fan of a pitchy colour. These Chafers live on many kinds of leafage, and are especially injurious to Apple and other kinds of orchard trees, where they are not only (in bad infestations) ruinous to leafage, but attack the fruit itself whilst it is still very young. They are especially injurious to Rose blossoms,—in fact when they come in the vast numbers, in which they occasionally appear, are a severe visitation. In their outbreak at Haslemere last season, it was noted that this "Rose Chafer" badly attacked Apples, Cherries, and Plums. The Apples were especially injured, the remnants of leaves left on looking as though they were scorched; many of the young Apples were also destroyed. The whole Cherry crop was consumed. The air seemed full of Chafers, but the attack soon passed.

PREVENTION AND REMEDIES.—The simplest and best remedy turns on the flight time of these Garden or Rose Chafers being in the sunshine, or heat of the day. This is noticed in German preventive observation. Dr. Taschenburg observes, with regard to beating them down, that in this operation it is to be borne in mind that these little Garden Chafers are more active than the Cockerchafer, and fly about freely in the sunshine.

In a note with which I was favoured on the 22nd of June, by Mr. Allen Chandler, from Bunch Lane, Haslemere, Surrey, regarding the great appearance of these Chafers in that neighbourhood last season, he mentioned that he noticed "that these beetles never fly when the

temperature is low, or in the evening. When the sun goes down you can shake them off the trees easily." "But," Mr. Chandler also noted, "unless you put a sheet underneath the trees, you would never find them, as they seem to disappear the moment they touch the ground."

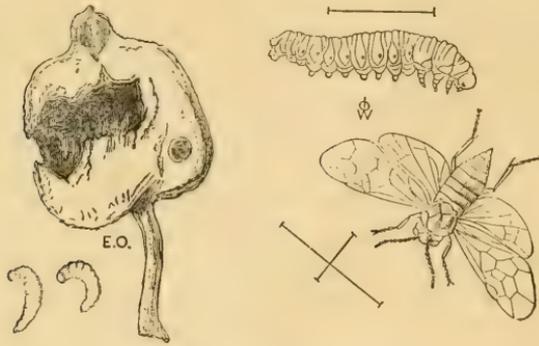
The German method of collecting is to beat or shake them down at whatever time they are found to be most torpid (whether in the evening, or in the cool early morning hours) on to cloths, or sheets, or anything spread below the boughs which will allow of shaking the beetles together and destroying them. An inverted umbrella is particularly mentioned as a convenient receptacle. This would be useful on a small scale of working, as for Roses or the like; probably in orchard work the attendance of the pigs, which are invaluable in similar operations with Cockchafers, would be also useful here, and might save the trouble of spreading anything beneath the trees to collect into. But whatever method is followed in the detail of beating down, the important point is that it should be done when the beetles are torpid. If they are in active state, some of them will be sure to escape, as noticed by Mr. Jenkins (see p. 7). Each female is considered to lay about a hundred eggs, so that the escape of even a moderate amount of the Chafers may set on foot a great deal of mischief.

For destruction of the maggots in the ground the remedy recommended by John Curtis is to water the infested land in autumn with diluted gas liquor. This in the proportion of one-tenth of gas liquor to nine-tenths of water is stated to kill the grubs without doing mischief to the Grass. But it would be well to experiment on a small scale, as to both these points, before giving a general application. Salt and water is also mentioned as serviceable, but it is very difficult to give fluid dressings at a strength which will do no harm to the surface growths and yet be strong enough to kill the grubs when the application has filtered down through an inch or two of soil.

Dry dressings, such as lime, gas-lime, ashes, or dry earth sprinkled with paraffin, or similar application, might be of service as a protection from attack to lawns, but would hardly be applicable on a large scale. Where the maggots are known to be lying near the surface in land which can be disturbed, it is well to open the surface with scufflers, and let birds or pigs clear the maggots, and in case of birds resorting to infested Grass-land, they should not on any account be molested.

But in the case of this infestation, the best preventive course appears to be when the beetles are observable, to beat them down from the bushes, but taking care that this shall be so done, either by choosing a time when they are torpid, or using precautions before mentioned, that the Chafers shall have no chance of flying away to start new infestation.

Apple Sawfly. *Hoplocampa testudinea*, Cameron; *Tenthredo testudinea*, Klug.



HOPLOCAMPA TESTUDINEA.

Female Sawfly and caterpillar, magnified, with lines showing nat. size, after Prof. J. O. Westwood (see 'Gardeners' Chron.,' vol. for 1847, p. 852). Caterpillars, nat. size; and infested Apple.

In my Report for 1891, I gave observations from various contributors, noticing the serious injury caused by the caterpillars of the Apple Sawfly feeding within the growing Apples; and at the same time I drew attention to the likelihood of this infestation not having received the attention it needed, consequently on the method of attack, and also the appearance of the caterpillars, bearing a general resemblance to those of the Codlin Moth. The infestation was described by Prof. J. O. Westwood from his own observations, so far back as 1847, but since then (so far as I am aware) has not been specially brought forward in this country until last year.

Then, with the help of the observers whose names are given with their notes in Report mentioned above, we traced out the attack, almost completely, through its various stages, as a very definite orchard pest, but we were not able to complete the observations by identification of the caterpillars as those of the *Hoplocampa testudinea*, by reason of the proper time not having arrived for the emergence of the Sawfly from its cocoons.

During the past season this point has been added. The Sawflies, which developed in May from the cocoons formed by the caterpillars of which observations had been taken, show the infestation to be (as we then supposed) that of the species formerly known as the *Tenthredo testudinea*, Klug, now more precisely defined as the *Hoplocampa testudinea*. Other points, both of life-history, and also bearing on practicable measures of prevention of attack (including the possibility of removal of cocoons from the surface soil beneath the infested trees

depending on difference in methods of cultivation and nature of ground) have been added, which are reported, together with the description of the perfect Sawfly, in the following pages.

The general history of the attack, given in a few words, is, that consequently on the insertion of the egg of the Sawfly (during the blossoming time of the Apple) the Sawfly caterpillars hatch in the young embryo Apple, and feeding therein grow with its growth, until they cause much damage to the fruits thus infested, and sometimes to others near, to which they have the power of straying at pleasure. Presently they go down into the ground, form cocoons, turn within them to the chrysalis condition, and thence to the perfect fly, which comes out at the blossoming season of the Apples in the following year.

During the past season much fuller information than we possessed before as to details of the above points (which we require for dealing practically with the attack) were forwarded, especially in a series of careful observations taken by Mr. W. Coleman, of Cranfield, Newport Pagnell, Beds, which are given in the following pages. In this will be found many serviceable notes as,—the depth at which cocoons were found beneath the surface; also that though half-grown caterpillars will bury themselves, they do not form cocoons; that the appearance of the Sawflies from the cocoons took place about the middle of May; that the method of attack as observed was for the egg to be inserted into the calyx, or rather just below the calyx-leaves into the swelling forming the future Apple, and the sign of attack having taken place was a small orange-coloured mark. Also specimens of the perfect Sawfly were forwarded, showing it to be the *H. testulinea*, and further observation was sent of differences in marking of the caterpillar at different stages of its life.

Mr. Coleman's communications during the past season commenced by a report sent me on Feb. 24th of the *depth at which he found the cocoons* under special observation:—

“A ten-inch pot was filled with earth from the soil surrounding the Apple trees. A number of infested fruits were placed on the surface of the soil, and allowed to remain until the caterpillars had fed themselves to maturity, left the fruit, and burrowed down into the earth in the pot. This was carefully turned out about a month afterwards. The first cocoon lay at a depth of two inches, more at three inches, and thickly at four inches, and in one instance the caterpillar had gone down seven inches before laying up; but this might be on account of the soil being more friable and hollow than would naturally occur in open ground in its natural state. For practical purposes the depth may be taken as similar to that of other Sawflies of similar habits,—Gooseberry, &c.

“These cocoons are restored to the soil for future observations ; at the present time the caterpillar is unchanged inside as it left the fruit in July,—alive and perfect.

“There is no evidence of the caterpillars either crawling down the trees to bury themselves, or of crawling up the trees from a fruit that has fallen before they (the caterpillars) have matured, but there is almost no doubt of their dropping to the earth independently of the Apples, as they appear to drop when released from the fruit from an indefinite height without injury. This was repeated again and again to account for the fact that a great many infested (recently) Apples remained on the trees after the caterpillar had disappeared ; *but as single specimens, so far removed from any other fruits that they would not be reached by the caterpillar in the fattened sluggish state of nearly full maturity.* Also in an instance or two where only three or four fruits remained all infested,—the caterpillars being present,—subsequent examination showed that the caterpillars had gone, whilst the fruits remained. Query—Where did they go unless they dropped to the earth ?

“The evidence would tend to prove also that the caterpillars in their immature state do not fall so generally with the fruits as might be supposed. They appear to leave a fruit before it has lost its vitality enough to fall, and if a violent wind or shaking brings them down by other than a natural falling, the caterpillars are immature, and cannot perfect their changes, consequently perish.

“I may state here that a caterpillar half-grown will take the ground as the full-grown specimen ; some of various sizes were so allowed to burrow in the pot, but only cocoons representing the number of matured caterpillars are found after a month.”—(W. C., Feb. 24th).

On May 19th, I was further favoured by the following notes of observations made by Mr. Coleman, *of the date of appearance and method of attack, &c., of the fly*, and other points of very practical, as well as scientific, interest in the life-history of the Apple Sawfly.

May 19th. The cocoons.—“The flies are now hatching from these simultaneously, both from the earth in the pot, and from open ground beneath the Apple trees ; the first in captivity showing itself on the 14th May ; on the 16th two or three more made their appearance.

“From the 14th, the earliest of the Apple trees, and those most profusely blossomed, were carefully watched (bush or pyramid trees), and on the 16th the fly was observed amongst the blossoms. Since that time the number is indefinite, as about fifty have been captured and killed in a search through as many trees.

“The flies hatched out in captivity were immediately placed in a

glass jar with Apple blossoms full-blown (a twig of same) and tied over with coarse muslin, a fresh bunch of blossom being introduced as the first withered, and the flies left to work their natural course. The trees most gay with blossom and setting their fruit, were then carefully examined, and the work of the Sawfly was then clearly shown. The deep orange-coloured mark on the embryo Apple, about the size of a small needle's eye, *underneath* the blossom, or rather the *calyx*, was its mark left.

“Returning to the captive's flies, the same work was plainly to be seen; but they having only blossom stalks to operate upon, the embryo Apple being yet unformed, with the same unerring instinct guiding them, had stabbed the stalk just below the calyx. The same day this was actually observed on the tree,—the fly head downwards on the stalk, curling its body, and driving its apparatus into the swelling Apple.

“In all instances the same point was selected, whether on blossom stalk, or embryo Apple from which the petals of the bloom had fallen, a point underneath the calyx, and what would represent on the upper section of the Apple, about its centre. The flies enter the blossoms for feeding purposes undoubtedly, as with ordinary dexterity they may be captured by pinching up the petals sideways and from underneath, when the head is down in the cap of the blossom.

“*The pupa-state.*—As some of the caterpillars were unchanged, though alive and perfectly healthy at the time of the first hatching, it follows as a matter of course that the pupa-state must be a short one, and also that these will hatch *after* the time of the Apple blossom, and when the young Apple will have swelled considerably, so this will confirm the foregoing as to operations on the *fruit*, and not the blossom.”
—(W. C.)

With the above notes (sent me on May 19th), Mr. Coleman also forwarded me for examination several *live* specimens of the Apple Sawflies; and on the 7th of June he forwarded four more (dead) specimens of the flies, or (to speak more technically) of the *imago* of what proves, on careful examination, to be (as we conjectured would prove to be the case) the *Hoplocampa testudinea*.

This species has the body yellow, or reddish-yellow, on the under-side; a large patch on the top of the head, also the top of the body between the wings, black, shining and very minutely punctured; the back of the abdomen also black. The shoulders, legs, front and sides of head, and the antennæ (or horns), yellowish, some of the middle or lower joints of the antennæ being partially marked with brown above. The wings transparent, with veins dark, or darker towards the base, and the *stigma* (or patch on the front edge of the fore wings), dark, but

paler or yellowish at the end nearest the tip of the wing. Length of the body about one-quarter of an inch.*

The caterpillars of these Sawflies, of which many specimens were sent me of which detailed account was given in my Report of Observations of 1891, † were, when apparently full-grown about July 14th, in length between three-eighths and half-an-inch; whitish or creamy in colour; head pale chestnut, eyes black, jaws dark brown in front, and the plate above the tail, and the cross-band immediately preceding, mottled with grey. The three first segments each furnished with a pair of jointed legs; fourth segment legless; the fifth to the tenth segments each furnished with a pair of sucker-feet, somewhat like blunt tubercles, and the tail segment also furnished with a similar pair, the caterpillar or larva thus possessing twenty feet in all.

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

Still tracing the changes of appearance backwards ‡ up to the commencement of life out of the egg, I have the following observation from Mr. Coleman:—"The caterpillars when first hatched are scarcely visible to the naked eye— $\frac{1}{32}$ -inch or less in length—head and body transparent, or nearly so; the eyes black, and a faint shade of chestnut on the helmet and tail piece; in a very short time the shining black head and tail makes its appearance, when the caterpillar is about one-eighth inch in length. There may be a moult, but have not been able to notice this, as the specimens are so small at that stage. They are very ravenous, and soon leave the first Apple unless it happens to

* The above description is taken from careful comparison of the specimens sent me by Mr. Coleman, with the description of the *Hoplocampa testudinea* given in 'Mon. of Brit. Phytophagous Hymenoptera,' Cameron, vol. i., p. 258; and also the description by Prof. J. O. Westwood in the 'Gardeners' Chronicle' for 1847, pp. 851, 852, of the same species of Sawfly under its synonyms of *Tenthredo testudinea*, of Klug and Stephens. The species having been described under such various synonyms by various writers, I have thought it perhaps best to add the name of "Cameron" at heading, as the authority quoted, Mr. Cameron's valuable work being our British Text-book of Phytophagous Hymenoptera.—Ed.

† See 'Report of Observations of Injurious Insects during the year 1891,' p. 3, by Ed.

‡ I have given the different varieties of appearance in this order, as it is in its developed condition that the caterpillar is best known.

be one more developed and fleshy, and commence another. Hence the rapid destruction of the young fruit in proximity."—(W. C.)

When full-fed the caterpillars go down into the ground, where they form cocoons in which they go through their change to the pupal state, and thence to the perfect insect. In the instances which came under my own observation the caterpillars buried themselves about the middle of July or rather earlier. Dates of change of condition of caterpillar within the cocoon, and various depths at which the cocoon was formed, will be found in the foregoing pages.

Returning now to Mr. Coleman's notes of observation of this Apple Sawfly attack during the past season. On June 3rd, he forwarded me specimens of young fruit containing the recently hatched caterpillar of the Sawfly, and additional notes of his observation regarding firstly,—dates of appearance of the Sawflies, and subsequently of the caterpillars:—"The flies appeared on or about the 14th of May, and disappeared on or about the 28th. The caterpillars are now fast hatching out; first noticed on the 28th May. They are certainly appearing earlier by ten days or more this year;" . . . "the eggs must have lain dormant last year until the middle of June.

"The fly itself appears somewhat delicate, and will not bear rough handling at all; the slightest interference too, in the intermediate state of its being, causing its death. This makes me think that affected Apples which fall early and in great numbers from the tree, seldom contain a caterpillar; but, if they do, are in such a withered state that they cannot sustain the life of the caterpillar to maturity; it will leave, and take the ground only to perish. I do not think they return to the tree."

Mr. R. Murray, writing from Walton House, Walton, Ipswich (on Dec. 28th, 1891), similarly noted benefit from killing the pest in fly condition, as follows:—"I think I did good service in killing the Sawfly in the act of laying the eggs in the bloom. As mine were mostly espaliers, I was able to look over them with the help of a small piece of stick and a light long nail, and killed the fly on the bloom."

Writing further on July 22nd of this year (1892), Mr. R. Murray added:—"I have been very busy this year again with the Sawflies, as the first one appeared on May 17th, when I began killing them as fast as I could on the Apple bloom, and before my blooms were over there was not one to be found. There was not one to be seen during a late blossoming (tree called 'Pendul Platt'), and consequently I thought by killing them I had prevented any eggs being laid, but this was not so, as later on I found a great number of Apples in which the grub was found, especially in the pyramid and standard trees, where I could not overlook their movements so easily as on espalier trees. I had a daily survey and inspection made of the Apples on each tree, and all those

with the matter oozing out taken off and burnt, so I think all the grubs in this way have been destroyed; and the Apples, a large number left, are perfectly sound.”—(R. M.)

PREVENTION AND REMEDIES.—On the 19th of May, Mr. Coleman wrote regarding the first step in the preventive operations, namely, *preventing egg-laying*:—“There is nothing that can be done at the present moment but to go for the fly in the blossoms. Amongst bush trees the task would not be so great as at first apparent. They are not in such vast numbers as some other insects, but *one* fly will pierce many Apples.

“As the flies in captivity died in a week or so, though supplied with trusses of blossom, and they could not be found in the open after fourteen days, it would appear that the life of the fly is contemporary with the period of the *blossom only*. This is quite enough, however, for a destruction of fruit out of all proportion to their numbers.” . . . “The destruction of a single fly is worth the trouble.

“After the blossom has fallen, the best thing to do would appear to pick out the spot-marked fruits where within reach, and spray the trees and young fruits with some poisonous substance, as Paris-green, which would probably kill many on attacking the second fruit. The removal of the earth beneath the trees and burning it, may avail in the case of large orchard trees, but would cause some chagrin to the gardener whose trees (bushes) should have a mass of fibrous fruiting-roots close to the surface, or at least above where the cocoons would be or amongst them, it would be a very destructive remedy. For my orchard, the soil being clay, the trees are moulded like large anthills round the base. These little mounds where the cocoons lie are full of fibres, on which rest the hopes of fruit production versus wood growth.

“There is no doubt it is the cultivated grounds that are most affected; grass orchards do not suffer much.”—(W. C.)

With regard to the treatment of disturbing the ground as a means of destroying the cocoons, it will be seen that as at Walton, from the nature of soil, the breaking up the surface was a requisite operation, the remedy *could be* carried out satisfactorily, Mr. Murray noted:—“I have found much benefit in continually stirring the ground, keeping it very friable. As our soil is light and sandy it cakes, and becomes like brick in very hot weather which prevents the small roots obtaining any nourishment, and so formerly our Apples have failed in that way as well.”—(R. M.)

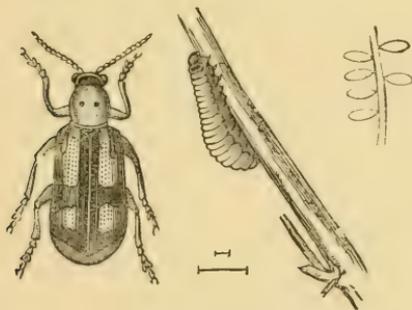
Where trees are grown under the circumstances above mentioned (or under any circumstances by which the root fibres lie so near the surface, that disturbing the surface soil is injurious to them), it would

obviously be very hurtful to search amongst them for the Sawfly cocoons. But where the operation can be safely performed, it would appear, both from recorded experience and what might be expected to happen, that such treatment, or removal, or replacements of surface soil, as would destroy, or remove, or bury down the cocoons, is a good measure of prevention.

Observations from various quarters in the last year have shown that, where the Apple blossoms are in reach, it is very practicable, and also very serviceable, to destroy by hand the Sawflies in the act of seeking a place for egg deposit on the blooms. If to these preventive measures is added that of keeping watch on the young fruit, and destroying all that shows the mark of infestation mentioned at p. 13, also gathering up what may be fallen, and destroying it on the chance of the caterpillar being within, it will probably be found that little more is needed in order to keep the attack in check.

ASPARAGUS.

Asparagus Beetle. *Crioceris asparagi*, Linn.



CRIOCERIS ASPARAGI.

Asparagus Beetle, larva, and eggs; all magnified. Nat. length of egg and beetle given by the lines.

The Asparagus Beetle, or "Cross-bearer" (as it is sometimes called, from the peculiar cross-like marking on its wing-cases), is an infestation of which the history has been well known here for more than forty years, and its existence as an occasional trouble to Asparagus growers, both here and on the Continent of Europe, has been recorded for a much longer period. At a comparatively recent date, this species has made its appearance in America, and at the present time is noted as

having advanced as far north as New Hampshire.* This is one of the most northerly of the United States on the eastern coast, having about eighteen miles of somewhat marshy sea-shore; and the migration of the beetle is of some practical interest as another example of the capability of our insect infestations for spread in America; whilst (probably on account of our island climate being unsuitable for their propagation) the American insect pests have hitherto not gained the same amount of footing here.

This "Asparagus Beetle" sometimes appears (as noted by John Curtis †) in great numbers over a large area,—as in 1836, when every plant examined on many acres of Asparagus beds from Battersea to Kew, and also at Hammersmith, was infested during summer and autumn,—and then it may totally disappear. But so far as my own experience goes, I should say that, on the scale of common garden cultivation, it is just one of the attacks that may be very much lessened, or even stamped out, by remedial measures being taken on its first observation. In a garden which I occupied for awhile near Isleworth, the Asparagus was so exceedingly infested that I had full opportunity of observation; and as, from the occasional enquiries still forwarded, the attack and very simple remedial treatment requisite do not seem as generally known as could be wished, it may be of service to notice them now.

The beetles are about a quarter of an inch long; of a blue-black or deep blue-green colour; the horns black; fore body (thorax) reddish, with two black spots above; the wing-cases ochreous-yellow with dark bluish, or greenish, ground colour, so arranged in a stripe down the centre, a transverse band, and a patch or spot at the base and tip, as to form a kind of cross-shaped marking, whence the occasional name of "Cross-bearer." The wings are ample, and the six legs somewhat long.

The eggs are somewhat spindle-shaped, dark coloured, and are fastened singly by one end along the shoots, or on the unopened flower buds. The grubs are fleshy, of a dirty olive or slate colour, cylindrical, somewhat lessened in size towards the head, which is small and black. The three segments next to the head are each furnished with a pair of black claw-feet, and the tail extremity, which can be curved partly round the supporting stalk, is furnished with a fleshy foot, these together giving the grubs such a firm hold that it is not easy to pick them off. Also the power which the grub possesses of exuding a fluid of a dark colour from its mouth, on any alarm, is probably a great protection against natural enemies. The grubs are stated to be full-fed

* See 'Insect Life'; Periodical Bulletin of U.S. Dept. of Agriculture, No. for August, 1892, pp. 395 and 401.

† See 'Gardener's Chron.,' vol. for 1845, p. 592.

in a fortnight, and then to go down into the ground, where they form a cocoon, and change within it to the pupa, from which, in about two or three weeks, the beetle comes up to start new attack.

The insects may be found in all stages from June, or earlier in the summer, until the end of September, and the light brown condition of shoots, or even of whole plants of Asparagus which have been killed by the attack, are a plain sign of the presence of the infestation.

PREVENTION AND REMEDIES.—When attack is found present, the measures most needed are any treatment which will make the grubs fall, and either by destroying them, or making the shoots disagreeable to them, preventing their return. Syringing with water, as warm as can be used without injuring the leafage, acts very well in making the grubs loose hold (especially if a smart tap is given to the shoot directly afterwards); and dry soot thrown over them *at once*, while on the ground, has been found very satisfactory in preventing their return to the plants. Dipping the infested shoots in a mixture of half a pound of soft-soap, a quarter of a pound of flour of sulphur, and about the same quantity of soot, mixed in a pail of warm water, is a remedy which I have previously noticed as answering well by clearing the grubs off thoroughly; and with a syringing on the following day to clean the plants, they soon regain their healthy appearance.

The above methods are of old standing as being successful, but probably some of the regular trade mixtures, which have become purchasable in this country in the last few years, would answer as well or better, and save a deal of time and trouble. Such are the mixture of soft-soap and sulphur, sold under the name of the "Chiswick Compound," in which the sulphur becomes perfectly dissolved after being mixed for about sixteen hours with water; or the mixture sold under the name of Little's "Anti-pest," composed of soft-soap with additions, making it in some degree similar in action to the mineral oil emulsions, so much relied on as insecticides in American use.* With the help of these, and the (also) recently introduced "Knapsack" sprayer, probably the Asparagus Beetle infestation could be promptly cleared from Asparagus grounds, even where it is cultivated by the acre.

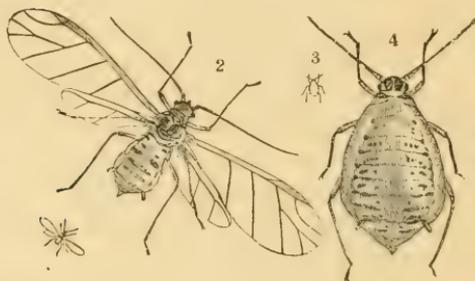
Beetles may, to a certain extent, be got rid of by having careful workers, who will not shake the plants until the right minute, to jar the stems so that the beetles may fall into a pail of any sticky material held below to receive them; and sometimes it is worth while to sacrifice some of the shoots in order to destroy the eggs before hatching, taking care to burn these infested pieces; also hand-picking of the grubs is of some service if salt or soot, or something unpleasant to the creature,

* For addresses where these mixtures are purchasable, see Index.

is held in the hand, so as to induce it to loosen hold; but the surest way to reduce the pest without damage to the foliage is to destroy it, whilst still in larval or grub state, by some of the various measures suggested.

CABBAGE.

Cabbage Aphis; Turnip-blossom Plant-louse. *Aphis brassicae*, Linn.; *Aphis florib-rapæ*, Curtis.



APHIS BRASSICÆ.

1 and 2, male Aphis; 3 and 4, wingless female (nat. size and mag.).

About the 9th of August specimens of an infestation which was then doing much harm to his Kale seed plants, was forwarded to me for identification by Mr. John Moss, of Feering, Kelvedon, Essex. This proved to be of the kind of Aphis, or Plant-louse, commonly known as the Cabbage Aphis, which is not only to be found in summer in great quantities on the leafage of Cabbage, or plants of the Cabbage kind, but also amongst the flowers.

Under the name of the "Turnip-flower Plant-louse," it was described by Curtis as being noticed by him in multitudes "amongst the short flower-stalks of the early white Turnip when a few only of the flowers are open. They were of various sizes, but all apterous" (wingless) "at that period; by the middle of August, however, they had increased to very large companies, with a few winged specimens. This species is readily distinguished by its white dusty appearance with which both sexes are thinly coated, as well as by the short, conical, and black tubes."

At the present day (*vide* Buckton's 'Brit. Aphides,' vol. ii., p. 33) this species is considered to be the same as the *Aphis brassicæ*, or Cabbage Plant-louse. Like most other kinds of Aphides, these are to

be found as males, winged and wingless females, and in young state resembling the fully developed insects in shape, excepting in the absence of wings; these being known commonly as *larvæ* during the first stages after being produced alive or hatched; and afterwards, when they have developed wing-cases, but not as yet wings, as *pupæ*.

When first hatched the larvæ are stated to be shining and bright yellow; with advance of age to be of a dirty grey much corrugated, and the wing-cases of a dark or grey black. The wingless female producing living young is given by Buckton (when without the powder) as of a greyish green, with eight black spots down each side of the back, those nearest the tail being the largest; horns green with black tips; eyes, legs, cornicles (honey-tubes), and tail, black. The winged egg-laying female is given as having the head, neck, lobes of the thorax black, and the rest of the body yellowish green; horns and cornicles dark brown; tail dark brown or green; legs dusky brown.

There is much difficulty in certain identification of the different kinds of Aphis infesting Cabbage and Turnip, but their method of life is so far alike as to make them all fall under the same kinds of treatment. The general rule is that the male Aphis does not appear until autumn, a little before the appearance of the wingless egg-laying female. Between these pairing takes place, and the wingless females lay the eggs from which proceed the infestation of the following year. The appearance of the male only occurs in autumn.

If we could get at the eggs, or find that the Aphides passed the winter in any accessible shelters, then we could work satisfactorily towards lessening the infestation; but as the case stands, no method of destroying them, on the scale of open garden or field work, appears to be known excepting the use of washes.

Soft-soap washes, or soap suds with various additions to make them more poisonous or deterrent, have long been used with greater or less success for garden service; but until lately there has been great difficulty as to any reasonably practical method of *applying wash* in field cultivation of root crops. In the last few years, however, much improved soft-soap mixtures have been introduced, as soft-soap and sulphur, soft soap and mineral oil, or other mixtures which must as surely do good in lessening amount of these Aphides, or Plant-lice, on Turnips or Cabbage, as the various and long-used soft-soap washes do yearly as a preventive of Hop Aphis. But there is the very great difficulty still to be met of *how to get at* the infested plants.

In very many cases the action of the large implements cannot be brought to bear, from the method of arrangement of the crops, as Turnip, Mustard, &c., which do not usually allow room for the washing-machines, however much good they might do; and the fine and gradual work of the implements which can be carried on a man's back runs up quickly in cost at the rate of field work.

The proof, however, of destruction of the infestation, together with no harm, but rather good to the plants, is a great step onwards to arrangements for gaining this at a lesser cost; and (at my request) I have permission from Mr. J. Moss, of Feering, Kelvedon, Essex, to give the following observations of the satisfactory effects of the use of a mixture of soft-soap and sulphur applied by the "Eclair" knapsack sprayer in getting rid of presence of Aphides from the Kale seed plants, but at the same time noting the costliness of the application over the large acreage infested.

Mr. John Moss wrote to me as follows from Kelvedon, Essex, on the 16th of August:—"I have tried the soap and sulphur compound with the knapsack sprayer for two years. The application is certainly very effective and satisfactory as far as efficiency is concerned, but the application is difficult at this season, and is also too costly. To thoroughly dress the Kale seed so as to kill all the Aphis is a very slow process, and costs nearly £2 per acre; we have, however, dressed some acres this year, very greatly improving the seed, or rather saving it. But to get over all our crops which were blighted would require from twenty to forty men, each with a sprayer, and just at the busiest season of the year, when they can least be spared.

"I find the total cost of dressing with the soap and sulphur compound to be about five shillings per day, and one man is able to dress about one-eighth of an acre. The cost, and also the acreage, would, of course, vary according to the extent of the blight and thickness of the crop.

"The seed crop would be dressed with but little damage to the seed. I find the soap and sulphur to answer better than anything else. The Chiswick Soap Co. made me up some with Paris-green, or London-purple, added, so as to make it a general-purpose compound, useful for either Turnip Fly caterpillar or Aphis; but for the latter I think the poisonous addition to be of no advantage.

"The bent tube that you suggested answers very well. I find holding the jet under the plants and directing the spray upwards to be the better plan. It thus has to pass the plant twice before it falls to the ground."—(J. Moss.)

One great recommendation of the compound mentioned, is that the sulphur in it is soluble without further trouble than mixing with hot water. When I have used it myself I have found that sixteen hours after mixing with hot water the sulphur was completely dissolved. The soft-soap used is of very strong quality, so that care is requisite to ascertain to what strength the mixture must be diluted before use.*

* For particulars, prices, &c., application should be made to the Chiswick Soap Co., Chiswick, Middlesex.

The soft-soap mixture previously mentioned at p. 19,* would probably also act very well for the same purpose as the above.

In reference to the observation of Mr. Moss in regard to mixture of Paris-green with the soft-soap, that he did not think this poisonous addition was of any advantage in treatment for Aphides, it may be remarked that mere poisons (as Paris-green for instance) which act by their *internal effects* only, and require consequently to be swallowed into the system to act on the insects to be got rid of, are of little or no use generally against Aphides. These feed by piercing into their food-plants with their suckers, consequently are very little affected by what may be lying outside. With them what we want is a sticky substance which will stifle them, choke up their breathing-pores, and be externally hurtful to them, and any additions such as those above mentioned, of sulphur, or mineral oil, or anything else which is obnoxious or hurtful to insect life, or of a nature to make the plants non-attractive, will do good.

Where the nature of the crop allows of good showers of water being thrown at it, this is beneficial even by itself, by means of washing off much of the infestation; and also, in dry weather, the mere fact of thus stimulating the growth of the crop and giving a freer flow of sap, is a deterrent in itself to the abnormally rapid increase of Aphides which takes place where the plant growth is stunted by drought, or made sickly by over-infestation.

But at present, for use in field cultivation, whether of Turnips, or Cabbage, or Mustard, the difficulty appears to me not to be either in want of knowledge of serviceable applications, or want of implements by which to distribute them, but that as yet (unlike the arrangements in our Hop grounds) we are unable (customarily at least) to get at our crops with the requisite implements to distribute the washes needed at a paying rate.

Cabbage-stem Weevil. ? *Baridius*, sp.



BARIDIUS CHLORIS.

Beetle and maggot of *B. chloris*, after Dr. Taschenberg; pupa of *B. picinus*, after Dr. Ritzema Bos: all nat. size and mag.

* A mixture in some degree resembling the kerosene emulsions so much used in the United States and Canada, and sold under the trade name of "Anti-pest," by Messrs. Morris, Little & Co., Doncaster.

On the 26th of June specimens were forwarded to me, by desire of Mr. C. Mervyn Doyne, of Wells, Gorey, Co. Wexford, Ireland, of a maggot infestation which was then doing much harm within the stems of Cabbage in that district. On examination of these very small maggots, and their method of working, it appeared to me that the infestation was in all probability that of a species of *Baridius*, a small long-snouted weevil, of which the attacks are well known on the Continent, although I am not aware of it being known as a crop pest here.

At the time of receipt of the specimens I was not, however (consequently on my own severe illness), able to attend to developing the larvæ sent up to beetle state, and on my subsequent application failed to procure beetles, so I cannot be absolutely certain of the nature of the attack; but as it differed from any other Cabbage-stem attack with which I am acquainted, I give the information in my hands, as far as it goes, for future reference. The note accompanying the specimens sent was as follows:—

“I am desired by my father to send you the enclosed young Cabbage plant, which has been attacked by a small grub which you will find more than half way up the stem. Nearly all the Cabbage plants in this district have been attacked in the same way by this insect, and when the grub works its way up nearly as far as the leaves the whole plant withers and dies.

“The grub seems to get into the stalk somewhere very low down near the root, and has destroyed plants where lime was put into the ground quite as much as in places where nothing was done.”—(K. D.)

The maggots sent were small and white, and obviously weevil maggots, and in appearance and method of attack (so far as material sent allowed me to see) the infestation resembled that of *Baridius*.

The following is the description given by Dr. E. L. Taschenberg of the habits of the maggots of the genus *Baridius*.—“The larvæ with which we are acquainted live by boring into various kinds of *Crucifera*, and consequently are very injurious to the different kinds of Cabbage of our kitchen-gardens, where they penetrate into even the smallest ends of the roots, eating them all out, and filling them with the dust from their workings. They develop, also, in the stems, to the pupal state, and in the latter part of the summer to beetles, which leave their cradle by means of a round boring, but where this does not take place these serve in some cases for winter quarters.”

This is the account of the general habits of the genus of *Baridius* given by Dr. Taschenberg. Of the *B. chloris* (figured in beetle and maggot state at p. 23), he gives the colour as shining green, sometimes with a bluish glisten; the length, without the proboscis, just under the sixth of an inch. The maggot is described as white, and somewhat glassy in appearance, and with yellow brown head.

The method of life of this kind (taken from various writers) is for the beetles which have lived through the winter and come out in spring to lay their eggs in the axils of the leaves, or even in the stems, of the plants of the Cabbage kind on which they may prey, if the outer rind is not too hard to gnaw through. The maggots, which soon hatch, gnaw their way into the stem and side branches, which are for the most part entirely eaten out, and filled with crumbly matter. In July the greater part of the maggots turn in a cavity to the pupal state, from which development to beetles takes place in about a fortnight. The beetles appear customarily to remain in their shelter; still not unfrequently they come out and hide themselves up for the winter. It is further mentioned by Dr. Taschenberg that he has found nearly full-grown maggots in Rape so early in the year, that he considers that many of the autumn beetles take the opportunity afforded by presence of winter Cabbage for egg-laying, and that the maggots from these eggs live through the winter.

Another species of *Baridius*, the *B. picinus*, differs in the beetle being of a shining black colour, and also differs from the above in frequenting Cabbage and Cauliflower, whereas the *B. chloris* more especially attacks Rape and Turnip.* The habits in other respects, and also the general appearance in larval and pupal stages of both the species above named, appear to be almost similar.

PREVENTION AND REMEDIES.—The chief measure of prevention is carefully drawing and burning all infested plants. It would be useless throwing these aside or burying them, unless very deeply down, as the beetles would come out much as if nothing had been done to them. At present we know very little of the attack in this country, excepting that much mischief was done in the district mentioned at p. 24 by an infestation agreeing in such points as were noticeable with *Baridius* attack; and information was also sent from a locality in Essex of damage to Cabbages, which were found to have the stems hollow. Under these circumstances it seems desirable to note the possible presence of an infestation, which may be much kept in check by a very little care.

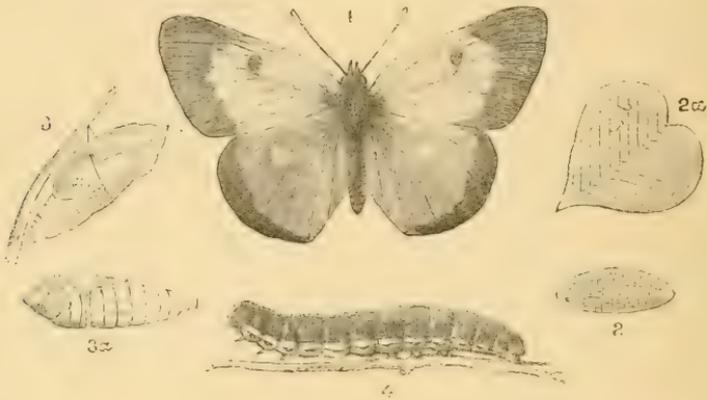
Observations were also sent regarding a good deal of damage caused by the maggots of the Cabbage and Turnip Flies (*Anthomyia* of various species) to Cabbage roots, and also of severe mischief caused by the fungoid disease, and distorted growth, commonly known as "Club" when affecting Cabbage, and as Anbury, or Finger and Toe, in

* The words in the German are "Rübsen und Raps"; several varieties may be included under these names.

Turnips. To save repetition, these will be specially noticed under the heading of TURNIPS.

CLOVER.

Clouded Yellow Butterfly. *Colias edusa*, Stephens.



COLIAS EDUSA.

1, butterfly; 2, egg, magnified; * 2a, leaf with eggs; 3, chrysalis suspended; 3a, upper side; 4, caterpillar.

The *Colias edusa*, or Clouded Yellow Butterfly, appears from time to time in great numbers in many parts of the country, sometimes scattered over a large district, sometimes almost as a flock over a Clover field. The caterpillars do not appear to be injurious to any notable extent; still, as they do feed on various kinds of cultivated trefoil (that is to say, both on the red Clover and the white Dutch Clover, as well as on Lucerne, and other kinds of *Leguminosæ*, wild or cultivated), the widespread appearance of the species again in the past season is worth record.

The bright yellow tints, and considerable size of the butterflies fluttering in large numbers on a sunny day over some Clover field which a flock may have selected for their presence, are an exceedingly pretty sight. My own first observation of such an appearance was at a date not long before 1860 (but of which I have not now a note of the year), when the butterflies were observed in such great numbers on a hot afternoon on a field of purple Clover in the west of Gloucestershire, just above the Wye, near Chepstow, that I was called to look at them.

* Caterpillar after W. Buckler, plate I., 'Larvæ of British Butterflies,' vol. i. Chrysalis and eggs from fig., p. 49, of No. of 'Entomologist' for March, 1878.

The butterflies vary much both in size and colouring. The spread of the fore wings may be given generally as from one and a half to two inches, but it may be less, or may run to as much as two and a quarter inches, or even more. The colouring of the wings cannot be better described shortly than in the words of Mr. Stainton:—"Deep rich yellow, with a broad black margin, which is spotted in the female, veined in the male. There is a constant variety of the female, which has the ground colour of the wings dull greenish yellow." There is a black spot in the centre of the fore wings, and in the centre of the hind wings an orange spot of variable size and depth of colour.

There is, however, much variety in tint and depth of colour between the full deep yellow and the above-mentioned pale greenish variety, sometimes distinguished as *helice*. Also there are differences in depth of tint of the black border, and amount to which this may be spotted in the fore wings of the female. The figure at p. 26 is from a male taken near Haslemere, Surrey, during the past season.

Notes are given by various observers of deposit of the egg, and subsequent growth of the caterpillar, being watched on various of the *Leguminosæ*, as *Trifolium repens*, "Dutch Clover"; *Lotus corniculatus*, Birdsfoot Trefoil; and *Medicago sativa*, Lucerne. The eggs are described as oval, pointed at each end, and placed upright, that is, fixed by one end on the surface of the leaf; the colour, at first yellowish white, changing through various shades of yellow, orange, red, or other tints variously reported by various observers. The time elapsing between egg deposit and hatching out of the larvæ varied in duration from about six to as much, in one instance, as twelve days; the eggs were noted in the observations of Mr. Buckler as being laid in successive batches, chiefly on fine sunny days, and the whole number amounting, in the instance where they were counted, to over 150, even before the butterfly had ceased laying.

The young caterpillars are usually described as green, but are stated by Mr. Buckler to be pale brown, or pinkish brown, on first emergence, which variation would account for the different tints noted as assumed by the egg before hatching. The colour afterwards remains green, dark, or dotted with very minute black points, each bearing a hair, the caterpillar, as it advances to maturity, having a white or yellow stripe along the line of the spiracles on each side. The caterpillars turned to the pupal state after a feeding time noted, in one instance, as from June 14th to July 7th, in another from June 24th to July 16th; but in a series of observations taken later in the year by Miss Sotheby, the larvæ which hatched on the 24th of August did not go through their final moult until after a longer period, not till Oct. 7th, this giving a duration of 43 days, instead of the 22 or 23 days of the summer duration of feeding time; and to this must be added that

the autumn brood, after their prolonged feeding time, all died before turning to chrysalis.

Possibly this fact, joined to the previous observation of egg deposit specially taking place on sunny days, may give a suggestion as to the requirements of the insect.

The figure at p. 26 shows the chrysalis suspended, like others of the same family, by a silken thread, or girdle, which helps to sling it to the stem on which it changed from the caterpillar state. The colour of the chrysalis is pale green, varied with yellow tints, black spots, and a stripe of dull dark red beneath.

The shortest time taken for development from the egg to the perfect butterfly is given by Mr. E. A. Fitch in 1877,—the year known, from the great prevalence of this insect, as the “*colias* year,”—from his own observations, as forty-three days, the longest as sixty-eight days; he also noted that it might now be considered that the *Colias edusa* was normally double-brooded, and occasionally triple-brooded.

The widespread occasional appearances of the Clouded Yellow Butterflies are visits that cannot fail to attract attention even from the unobservant; but as the butterflies vanish, and, from the similarity of colouring between the caterpillars and their food-plants, their presence is not very observable in the Clover, little record has been made practically; and the scientific record from daily observation is so inaccessible to a large proportion of the readers who would like to know the history of the occasional visitors, that in the above page or two I have endeavoured to give the main general points, from collation of the accounts of the authorities duly acknowledged below.*

In the paper by Mr. Fitch (referred to), notes are given of great appearances of the *C. edusa*, and also of the *C. hyale*, from 1821 onwards; but the first great appearance of which I had general observations myself was that noted in 1877 in my first Annual Report. Without going again into details, I may note that the *edusa* was recorded in that year as observed across the South of England from June to October, and in the Exeter and South Devon district it was recorded by Mr. Edw. Parfitt as literally swarming in the fields from June till September. The most south-westerly locality of observation of which notes were sent to myself in that year was the neighbourhood of Chagford on Dartmoor, but it was reported as common at Penzance and near the Land's End. In the eastern counties it was recorded as

* “*Colias edusa*,” by E. A. Fitch (then Hon. Sec. of Ent. Soc.), ‘Entomologist’ for March, 1878, with coloured plate. Notes by Miss Sotheby (same No. pp. 61, 62). ‘Larvæ of British Butterflies or Moths,’ by W. Buckler, printed for the Ray Society, vol. i., pp. 9—15, and plate I. Observations of appearances of *C. edusa* in ‘Report of Injurious Insects for 1877,’ by Ed. Also paper on “*Colias edusa*, *C. hyale*, &c., in England in 1892,” in No. of ‘Entomologist’ for Sept., 1892.

numerous in Kent, and present in Essex, numerous in various places in Suffolk, Norfolk, and some seen in Lincs. and Yorks., and also near Durham; and if to these a note is added of its observation near Carnarvon, by Mr. Bairstow, and presence in fourteen or more English counties, where it is also recorded either in my own report or in the report of Mr. E. A. Fitch, a very widespread presence will be shown in England.

In Scotland it was reported to me as early as June near Dumfries, after an absence of sixteen years, but was confined to Clover fields sown out in the previous year; and its *absence* also was recorded near Banff by the late Thomas Edward, and at the not distant locality of Inverurie, Aberdeenshire, by Mr. Tait, also one of my correspondents; but one specimen was recorded by him as seen in Orkney, on the 19th of June, in the same year, 1877.

The geographical area of this appearance of the Clouded Yellow Butterfly in 1877 may therefore be given as extending over a large part of England, from the extreme east and west of the southerly coast, and from Carnarvon at the north-westerly extremity of N. Wales, up to Dumfries in Scotland, and exceptionally to the Orkneys.

Looking over the records of appearance of the *edusa* in the past summer or autumn, as given in our entomological serials, and especially in the numbers of the 'Entomologist' for Sept. and Dec., it will be seen that the area, or range of appearance, in South Britain, has to a great extent been similar to that of 1877; but besides being again observed in Carnarvonshire, N. Wales, the records, given with name and locality of observer, show the presence of *edusa* to have extended from Monmouthshire, where it was common at Usk at the end of August, as far as Pembrokeshire, appearances being noted in the intervening counties of Brecknock, Glamorgan, and Carmarthen; and the *C. edusa* is recorded as having been "literally swarming in Jersey, as likewise in the other Channel Islands."

At St. Albans I had a note of the *C. edusa* being seen in the town by Mr. A. Ernest Gibbs, and I also saw a single specimen in my own garden, but much too wild for capture.—(Ed.)

Further north the area of presence has been extended, by observations of specimens seen at dates ranging from the 19th or 20th of Aug. to the 23rd of Sept., at localities near Perth; on a hill a few hundred feet above Loch Long, Dumbartonshire; on a mountain near Row, not very far from Glasgow; and at New Abbey, Kirkcudbrightshire.

In Ireland the appearance at Howth, Co. Dublin, is recorded as observed on Aug. 28th.*

* The above notes are taken from the 'Entomologist' for Dec., 1892, where the names of observers and localities will be found in full, as also (in the same paper) further records of localities of English observations.—Ed.

In each of the above Scotch and Irish observations (with one exception, where two specimens were seen), only one of the butterflies was noticed, and though in all reasonable probability there were more existent, still this paucity of presence, both in number and locality, contrasts strongly with the south-country observations, where it is recorded as literally swarming, or seen for twenty miles, along a railway, or, as I have myself seen it, in flocks on a field of Clover.

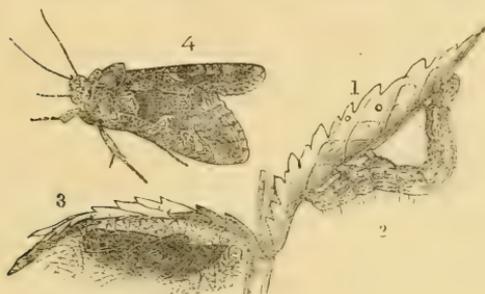
PREVENTION AND REMEDIES.—At present the amount of injury known to be caused is too slight to call for attention. Should mischief, however, be found to arise, one point to be looked to would be the food-plants. These are recorded as various species of Clover, of which the two commonly cultivated kinds, the "Purple Clover," *Trifolium pratense*, and the "White Dutch Clover," *T. repens*, are especially mentioned; two kinds of *Medicago*, the *M. sativa*, or "Lucerne," a regular crop plant, and the *M. lupulina*, often known as "Trefoil," or "Black Medick," a plant with small dense spikes of small yellow pea-shaped flowers, which grows in a wild state on waste ground, but which is sometimes sown on poor soil, or used for sowing in mixtures of Clover seed. The *Ornobrychis*, or "Sainfoin," is another crop plant which also serves as food for the caterpillars of the *C. edusa*, and the common *Lotus corniculatus*, the well-known "Birdsfoot Trefoil," is another food-plant named, besides such as may be included under the more general term of various leguminous plants.

In the notes sent to myself in 1877, such few observations of ovipositing or of feeding of caterpillars as were forwarded were in connection with "Clover," "White Clover," and "Trefoil"; and in the notes of Mr. E. A. Fitch of his observations made in that year he records deposit of upwards of two hundred eggs by one female on the 8th of June, on "Trefoil," *M. lupulina*.

With regard to the *capacity* of the caterpillar for appropriating their food-plants to their own service, it is mentioned by Mr. W. Buckler that young larvæ were hatched under his observation on Dutch Clover, and these, after their first change of tint, assimilated well in colour with the Clover, "of which they ate voraciously." Mr. Buckler also notes:—"The young larva remains on the leaf on which it was hatched, and on which it begins to feed, only wandering to another leaf when too many larvæ happen to be together. It is very quiet, and sits still and eats white transparent blotches on the leaf." Again, in the same paper, to which reference is previously given at p. 28, Mr. Buckler says of *C. edusa* caterpillars, which he watched as to their feeding habits on "two fine plants" of *Lotus corniculatus*, that "they continued to feed and grow, consuming a great deal of food, stripping bare the stems of plant after plant, appearing to be very hardy."

Though the *Colias edusa* does not rank amongst "injurious insects," still it certainly appears that a butterfly of which the caterpillars, when under supervision, are found "to eat voraciously," to "eat white transparent blotches on the leaf," or again, to "consume a deal of food," may prove to be an infestation requiring attention.

Silver-Y Moth. *Plusia gamma*, Linn.



PLUSIA GAMMA.

1, eggs; 2, caterpillar; 3, chrysalis in cocoon; 4, moth.

The *Plusia gamma*, or Silver-Y Moth, is an exceedingly common kind, and on the Continent of Europe, where its occasional great outbreaks are more frequent than with us, it is sometimes almost overwhelming in its ravages to various crops. Amongst those particularly liable to attack, cruciferous plants, as Turnips and Cabbage; leguminous plants, as Peas, Beans, and Clover (but *not* Lentils); and Sugar Beet, are especially noted. Flax also is such a favourite food, that the "Flax Moth" is one of its Continental names, as well as that of Sugar-Pea Moth, and the name of Beet Moth is also sometimes given to it. The Hop is another crop plant sometimes attacked by the Gamma caterpillar. The moth may be found by day and night, in the bright sunshine as well as in the dusk, and frequents all kinds of low-growing plants.

With us, except in 1879, the year when we shared in some degree in the extraordinary and widespread infestation of this moth, which spread from the north-west of Africa, across Europe to our own southern shores, I believe that we have rarely suffered seriously from this attack. The course and rate of advance of this most unusual migration was duly recorded at the time, from its first observation in the north of Africa in the neighbourhood of Algiers, about the 15th to the 20th of April onwards, to its appearance *via* Strasburg, Paris, and Ostend, on our own coasts, or in our southerly and easterly counties, at dates from June 10th to 13th.

The amount of infestation was enormous, and it is of some practical interest to refer again to the attack, just to note that though the most serious destruction (of which we have record) which was caused on their way by the caterpillars of the migrating hordes was to Sugar Beet in Saxony, yet of the "hundreds of thousands" of the moths reported at Ostend, these were mentioned as being principally on some Clover; and in this country, although the caterpillars were exceedingly injurious (as at Exeter, where they were noted by Mr. Edw. Parfitt as literally swarming on every garden plant, and defoliating the plants as well as riddling the leaves), yet, so far as I can find, the only crops which suffered were Peas, as for instance near Chichester, where it was observed "whole fields of Peas" were well-nigh stripped bare by the caterpillars.

In the past season some observations were again forwarded to me regarding severe injury from the Gamma caterpillars to Clover in different localities, the caterpillars in two instances (when they had devoured all that suited them of the Clover) being noted as migrating onwards, in one place to Potatoes; in another, some to Potatoes and some to neighbouring Hops; and in another locality they were noted as passing on from Clover to Rape, Swedes, and Mangolds. The eggs are generally laid beneath the leafage.

The caterpillars are in part recognizable by being "half-loopers," what are technically called "semi-geometrical larvæ," that is, they have *two* pairs of sucker-feet beneath the body, whereas the true loopers have only *one* pair, in addition, in both cases, to the pair at the end of the tail. Consequently, though they form an arch in walking, as shown in the figure at p. 31, they do not make a complete loop. The colours vary with age; at first they are stated to be very dark deep green with a mixture of brown, and when they are older they are considered to vary in tint with the colour of the leafage on which they feed, this presumably from the consumed leafage showing through the transparent skin. In this country it was considered by Curtis that after moulting several times, they became of a green colour, with a greenish-brown head. They have six fine whitish lines along the back, and a yellow line along each side, and are covered with short hairs. The sucker-feet are green, the claw-feet green or reddish-brown. When full-fed they spin a light woolly cocoon on a stem, or attached to a leaf. The latest brood winters, or may winter, in caterpillar state, and comes out again in spring to complete its growth, and, with us, the moth is present during summer and autumn.

The moth is about an inch and a half, or rather more, in the spread of the fore wings, which are of a satiny shine, variegated with coppery, grey, and brown, and marked in the centre with a bright silvery mark something like the letter "Y," whence the moth takes

its name. The hind wings are smoky, the body between the wings of a purplish-brown and crested.

Some of the specimens of caterpillars sent me varied much in colour, but looking at the differences that occur in this species, both according to age and according to what the grub may be feeding on, I see no reason to doubt that they were all "Gamma" caterpillars.

On the 1st of July the following note was sent me from Teynham, Sittingbourne, Kent, by Mr. Jas. F. Honeyball:—"I herewith forward you specimens of, to us, a new pest. I have two fields of Red Clover, the first cut from which has just been carted; we had lately experienced splendid rains, and the second growth should be already making good progress, but instead one piece is as bare as if it had been closely grazed by sheep, and the other nearly as bad; on close inspection I find innumerable caterpillars of the kind enclosed, which are evidently causing the mischief. I am proceeding to dress both fields, one with lime, and the other with soot."

On the 4th of July, Mr. Honeyball wrote further regarding these caterpillars, which he noted "are destroying our second growth of Clover in this locality." It will be seen the caterpillars were, at date of writing, in course of migration, which would be particularly undesirable in the case of Hops, this being a permanent crop, and in some notes by the late Edw. Newman, on this moth, I find he mentions recurrence of the infestation every year on a Hop in his own garden. Also it will be seen that in this case, heavy rainfall (in the shape of thunderstorms) does not appear to have been of any service in clearing the grubs:—

"Having cleared the Clover fields, the caterpillars, which I sent you specimens of, appear to migrate in search of fresh food; in one case they are now attacking Potatoes, and in another Hops." . . . "As to remedies I am trying fresh slaked lime and soot. A heavy thunderstorm experienced here last Wednesday, 0·67 rain, in about 1½ hours, *after* the first cut of Clover had been carted from the fields, cannot have been very fatal to the larvæ, as you point out was the case in 1879."—(J. F. H.)

On July 7th another note (also from a Kentish locality) of great appearance of Gamma caterpillars, was sent me by Miss Frances Pye, from Knights Place, Rochester. In this case the looper caterpillars were still young, but I found one was acquiring the paler adult tints, and, as in the previous case, having finished the weeds and Clover, so far as suitable to their tastes, were then migrating to another crop. Miss F. Pye wrote me:—"My father has asked me to send you these caterpillars. We have an immense number of them in our Clover field: they have eaten the Thistles, and *all* the young shoots of Clover, and are now marching across a road into a Potato field, where they

are very busy! The Starlings have found them out to-day, and will, we hope, clear them off.”—(F. P.)

Later on (on the 1st of Nov.), at my request for further information, Mr. James Pye, of Knights Place, Rochester, favoured me with the following notes:—“The ‘looper’ caterpillars totally destroyed the first shoot of my Clover, after it was cut the first time (it came again, but was very late). They then marched across a road 10 feet wide; but a very great shoal of Starlings found them, and ate them all up in a week, and stopped further damage.

“Mr. Hope, at Moldash, East Kent, had his Clover destroyed; they then devoured his Rape, and did great injury to his Swedes and Wurzels. There were several large fields of Clover destroyed in this district, but I did not hear of their doing other damage.”—(J. P.)

On the 13th of July, Mr. Geo. Simpson, of The Watering, Creeting, St. Mary, Needham Market, Suffolk, wrote, that, in common with many of his neighbours, he was suffering from the depredations of a green caterpillar on a second crop of Clover, and was desirous of learning the best remedy for the present attack, and how to prevent it recurring. The specimen sent showed the infestation also in this case to be of the *Plusia gamma*, and the caterpillar to be about half-grown.

On Nov. 3rd, at my request, Mr. Simpson furnished me with the following further particulars regarding the attack of the caterpillars to his Clover last summer, which it will be seen involve some very serviceable points. Firstly, the powers of the caterpillars as to making a complete clearance of all that was not too hard to eat; next, the important point that although the plants were thus eaten back that, with favourable weather, such fields as were left undisturbed made a good new growth; and, thirdly, the fact of the Rooks and Starlings flocking to the infested fields and doing good service. Mr. Simpson wrote as follows:—

“In my own case, I had two adjoining fields attacked; one where the first crop was cut late, they appeared on first, and cleared it completely, leaving the stubble brown and bare. This I immediately ploughed, and planted with Coleworts, but think from my neighbours’ experience that if I had had more patience I might have had a good second cut of Clover rather later. I have seen pieces which were quite bare, and which, owing to the showery weather, recovered, and came to a good swathe.

“My other field, which was six inches high when attacked, seemed to be too strong for the caterpillars to master, and after eating some of the bottom leaves, they disappeared, whither I cannot say, but I am inclined to give the Rooks and Starlings the credit of most of them. This piece of Clover eventually came to a very good crop.

“With regard to your question respecting the caterpillar spinning

a web? I did not notice any. They disappeared as suddenly as they came, but I know that thousands of Rooks and Starlings frequented the fields, and must have cleared off an immense number. I believe they are two of the best friends farmers have.”—(G. H. S.)

The following second report with which I was favoured on the 8th of Nov., by Mr. J. Honeyball, from Teynham, Sittingbourne, Kent, is of serviceable interest regarding migration of the caterpillars from the Clover; treatment, especially by rolling, which killed a good many on the Clover; also an estimate of damage on a part of the Clover crop; and also observation of the Rooks and Starlings in this case not volunteering as helpers. Mr. Honeyball reported:—

“Firstly as to the migration to Hops and Potatoes from the Clover: in each case they penetrated but a short distance, about two or three rods, but as far as they went the foliage was completely destroyed, leaving only the skeleton leaves of both Hops and Potatoes; if this sort of thing occurred on a large scale it would simply be fatal to Hop plants, and effectually prevent growth of Potato tubers; but I think it was necessity, and not choice, which led these caterpillars to seek what, I hope, was an unnatural food, it was not till almost every green leaf had disappeared from the Clover, that the migration in one case across a dusty road commenced. Possibly the reason they progressed no further into these crops was the arrival of the time for change into the pupa stage; on this point perhaps you will express an opinion?”

So far as I can find by search in all the works that I have at hand for reference, the precise time taken by the caterpillar from date of hatching to date of spinning a cocoon for change to the chrysalis, is not recorded. But it is stated by Dr. Taschenberg, that in the warm season of the year, the changes may be completely carried through all the four states (that is, egg, caterpillar, and chrysalis up to appearance of the moth) in six weeks. And as he also says that the time from the laying of the egg to the hatching of the caterpillar out of it is ten or fourteen days, this gives some amount of information of the rate of development.—ED.

“Secondly as to remedial measures: I rolled the two Clover fields one way with a ‘ring’ roll, and the other with a heavy plain iron roll, this crushed a good many, but not nearly all; I then dressed the land with a mixture of soap and fresh slaked lime. We also tried, on a small scale, the application of a decoction of quassia chips, which appeared very effective; the Strawsonizer would be a capital machine for distributing this liquid dressing.

“It strikes me that the reason my Clover suffered so much was owing to the time of cutting coinciding with the period of greatest activity (so to speak) in the lives of the caterpillars; for instance, one

of my neighbours had a Clover field adjoining one of mine, not even a hedge intervening. This he cut a few days later than I did mine; his second cut was certainly damaged considerably, but to nothing like the extent that mine was. Again, about an acre was left in one corner of my other field to be cut as 'green meat' for the horses, and was not touched until ten or fourteen days later than the other part of the field. On the plot so left but little mischief apparently was caused by the caterpillars. A fair second growth took place, in great contrast to the rest of the field, where the second crop absolutely failed (I suppose 80 to 90 per cent. of the plants were killed, and the remainder so enfeebled as to produce only a little autumn sheep keep). The reason I suggest is that when the mowing machine cut the Clover, the stems and leaves, unknown to us, were infested with caterpillars, which would be shaken to the ground, or would crawl off the stems they were on, as they became withered, and naturally seek the young fresh leaves which almost at once begin to be thrown up by the plant, and preying on these soon destroyed its vitality; while, in the case of the crop cut later, the insects had changed, or were rapidly changing, to the chrysalis state, and consequently the fresh young shoots escaped.

"I heard of another field in this locality which was freed of the pest by Rooks, but neither they nor Starlings came to my assistance."
—(J. F. H.)

PREVENTION AND REMEDIES.—For the most part these would depend very much on the nature of the attacked crop, and local circumstances, but where infestation has been noticed on beds of Nettles, Thistles, or other weeds often to be found growing round fields, where there would be no difficulty in rough mowing them, and burning them afterwards, this would help to get rid of many chrysalids in their cocoons, which presently would have sent out a new supply of infestation. Similarly if the caterpillars were seen at work where the food-plants could be destroyed at a little cost, it would answer to do so, taking care of course that the caterpillars were not allowed to migrate during the operation.

The occasional migration (noticed by Mr. Pye) of the caterpillars from one crop to another, puts them to some extent in our power. Where their course is across a fairly smooth road, a boy, or a couple of boys, with thick soled boots would for a very small sum so trample out the migrating pests that probably few would escape. Or if the advance of the caterpillars was too rapid to be wholly met in this way, probably the German method of digging a ditch across the line of advance, so that the grubs would be collected at the bottom of it for long enough for a boy running along the bottom to trample on them, would do all that was needed.

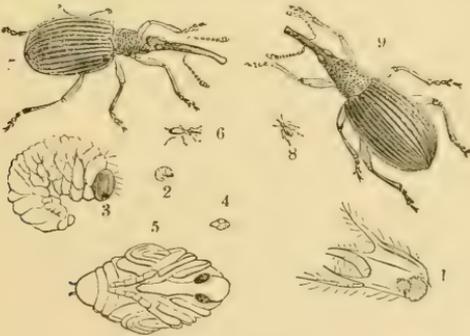
In large leaved crops, such as Turnips and Rape, the methods customarily employed for clearing caterpillars, such as brushing with boughs fixed on scufflers, would seem the best to be employed.

In Clover attack the only direct remedy which is mentioned as having been tried was rolling. This killed a good many of the caterpillars, though it was not wholly successful. For Hops or tall-growing plants or bushes where infestation was so severe as to make some special treatment necessary, probably soft-soap wash and the washing-engines would do all that was requisite, or in some cases shaking down, or hand-picking, could be carried out at a paying rate.

With some low-growing crops like Clover just started into second shoot, a good liming, or other manurial application of a nature to be good for the crop, and prejudicial to the grubs, could hardly fail to be of service.

But although the *Plusia gamma* is such a regular yearly presence, still we have so very few notes of it occurring as a serious crop pest in this country, that it may well be hoped it will continue to give us only occasional trouble, and that the inexpensive treatment of being careful that starlings, thrushes, and other birds which may congregate, to clear off the caterpillars or moths when they appear in unusual numbers, will be all that is required.

“Yellow-legged,” or “Dutch Clover Weevil. *Apion flavipes*, Fab.



CLOVER PEAR-SHAPED WEEVILS.

1, maggot, feeding, magnified; 2—7, maggot, pupa, and beetle of *Apion apricans*; 8, 9, *Apion assimile*: all nat. size and magnified.

The following observation refers, firstly, to damage by the “Pear-shaped” Weevils to Clover leafage, a branch of the mischief caused by them, which, though known of, does not seem to occur, or at least not to be observed, so often as that to the Clover seed, and of which I have not previously had any note. In this case the damage was caused to

leafage of the white Dutch Clover, by the *Apion flavipes*, the "Yellow-legged," or "Dutch Clover Weevil." The above figures are of two species of Clover-infesting "Pear-shaped Weevils" so nearly resembling the *A. flavipes* that they serve to show the minute life size, and also the general characteristics when magnified, especially the very long snout or proboscis, giving somewhat of a "pear-shaped" appearance to the Weevils, from which they take their common name. In each of these species the general colour of the Weevils is black, but the *A. flavipes*, or Yellow-legged Weevil, differs in being somewhat more slender in form; in the antennæ (or horns) being set somewhat nearer the base of the snout; and in the colour of the legs, which are bright ochreous, with black feet and tips of shanks. The species is very common, and was found by Curtis "in profusion in the month of May on the Dutch Clover."

On the 10th of August I received a packet of specimens of the injured Clover leaves from Mr. Geo. John Paine, of Risby, Bury St. Edmunds, Suffolk, with the following remarks:—"I have just harvested 18 acres of white Clover seed, and on going over the field last Friday I was much struck by the way it was breaking out from the roots, and the probability of its producing feed; but on going to the field this morning, I find the whole of the young leaves in the state of those I enclose for your inspection. As I have never had a similar experience before, and the white Clover growing in an adjoining field, and that growing in a pasture close by not being so affected, I should be very glad if you would tell me what is the cause of all this mischief."—(G. J. P.)

The specimens sent showed absolute destruction of the young leafage. These leaves were eaten away until little remained but the veins, forming a fine net-work, with here and there a little of the green tissue still remaining on one side of the mid-rib, or near the base of the leaflet. From the nature of the injuries it was presumable that these were caused by the "Pear-shaped" Clover Weevils, and on the following day the specimens sent me from the Clover stack from the infested field showed that the species at work was the *Apion flavipes*.

On the 11th of August, Mr. Geo. J. Paine wrote again as follows:—"Since writing you yesterday respecting my white Clover, I have discovered that the stack of seed is *completely covered* on the outside with a little black insect, a sample of which I am sending you by this post. These insects (which I think are a species of beetle) are no doubt the cause of the mischief, but I have never had the experience before."

The injury caused to the seed crops by various kinds of *Apions* is that most commonly observed. In 1886 notes were sent me of great harm being done to seeding Clover at various localities in Somerset-

shire by the Weevil maggots feeding in the seed-heads. In one case specimens were sent from a fifty-acre field of Clover, of maggots which were feeding at the base of the florets, and it was stated that every Clover field in the neighbourhood was similarly attacked.

The common method of attack, as noted in the case of the "Purple Clover Weevil" (the *Apion apricans*), is that it lives through the winter, and in due season the female Weevils lay their eggs in the blossoming Clover heads. The maggots from these feed on the forming seed, and turn to chrysalids (to some extent at least) in the dying flowers. From these chrysalids Weevils develop in a fortnight, but with the late brood some may remain in chrysalis state until spring. In regular course of life the first brood of beetles develops in time to start a second brood to infest the second crop of Clover. They may be seen swarming out in numbers from the Clover stacks where they have been stored in chrysalis state, and are ready to do mischief, firstly, by devouring the leafage themselves; next, by laying eggs in the Clover heads.

So far as I know, we have not any notes of the change from chrysalis to beetle taking place amongst the root leafage, or on the ground, but I have myself found the maggots straying about in the flowering heads, and there does not appear to be any reason why these, if they fell to the ground, should not develop in any shelter there as well as in the heads. And in the case of the injury to Mr. Paine's young Dutch Clover, as this was noticeable as severe before the beetles were noticed to be escaping from the stack, this appears to point to the enemy being on the field.

On the 17th of August, Mr. Paine wrote further respecting the infestation of his Dutch Clover:—"As regards the field I cannot now perceive any there;" . . . "but my stack and stackyard are still infested, indeed quite alive with them."—(G. J. P.)

PREVENTION AND REMEDIES.—So far as I am aware all the recorded measures refer to prevention, and mostly for the purpose of preventing injury to the seed-heads. I do not find any notes of treatment as a remedy to beetle presence on the leafage, although the injury was described as long ago as 1844, by Mr. W. Trenchard, of Sherborne:—"I have a field of Clover which has been twice mown, and there is now a fine aftermath. The part of the field near the stack has been lately attacked by a small black Weevil, which advances in a semi-circle, totally destroying every leaf, leaving only the fibre. I should think there are on some of the leaves as many as 100 or 150. Since last night they have eaten nearly as much as would have kept a sheep."—(W. T.)*

* Curtis' 'Farm Insects,' p. 477.

One means of stopping spread of mischief would be destroying these enormous numbers of beetles spreading from the stacks as mentioned above. The beetles develop from the chrysalids which have been carried in the Clover seed-heads to the stacks (or from the maggots which are nearly full-grown, and on the point of changing to chrysalis), and so the Clover seed stacks become centres of infestation. The "Purple Clover Weevil," *A. apricans*, is known to have "two ample membranous" wings folded beneath the hard wing-cases. The "Dutch Clover Weevil," the *A. flavipes*, I have myself found has also wings, and by means of these wings the Weevils (that possess them) can easily transport themselves at pleasure back to the Clover fields where their early life was passed in the seed-heads. But after examination of a good many specimens sent me (all of which had presumably developed within the Clover stack before mentioned), I could not satisfy myself that the wings were in all cases sufficiently formed to be serviceable for flying purposes. This condition may have been incidental, or may have been some crumpling of the membranes, from the difficulty of spreading specimens, which were so much dried as to require relaxing for examination. Still, the point may be worth mention.

Where the pests are appearing in the great quantities described, it would probably answer in all ways to have some quick-lime, or if procurable, some gas-lime in caustic state, shovelled on them from time to time, and so prevent their spreading abroad.

But with regard to general measures of "prevention"; these turn on *preventing* formation of the seed-heads in which the maggots feed, and are shortly, as laid down by M. Herpin many years ago:—"Avoid allowing the Clover which is much infested by the Weevil to ripen and run to seed.

"Cut early, and feed off while green, the Clover crops which are known, or supposed to be, much infested by the *Apion*.

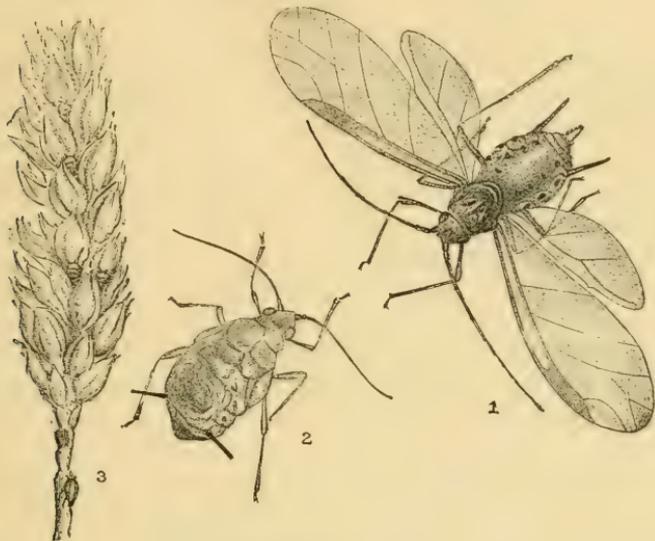
"Carefully avoid allowing the Clover crops to remain more than two years in succession on the same ground.

"Alternate and vary the culture."

The *A. flavipes* may be found on the purple as well as on the Dutch Clover.

CORN AND GRASS.

Corn Aphis or Plant Louse. *Siphonophora granaria*, Kirby;
Aphis avenæ (Fab.?).



SIPHONOPHORA GRANARIA.

Winged female; young Aphis, magnified; and infested Wheat ear; after Buckton.

Corn Aphid is only an occasionally serious infestation in this country; but in 1885 it was exceedingly prevalent, and in last season it was to this attack (and to that of the mildew or rust, often known as blight) that much of the loss on Corn was apparently to be attributed.

The winged female figured above, magnified, is somewhat more than a quarter of an inch in the spread of the wings; of a pale brown or rusty yellow, but the thorax brown, with darker lobes above, and the abdomen shining green, with four well-marked black spots on the back, and some black spots on the sides, and the honey-tubes (cornicles) black; legs yellow, with black knees and feet. In the early stages the colour is given as (typically) green of some shade. The wingless female, producing living young, is also given as green or brownish green. But though this *S. granaria*, typically considered, has much green in its colouring, a very large proportion of the "Wheat Plant Lice" are often of some shade of brown, and much correspond with the Oat Aphid, *Aphis avenæ*, of Fabricius.*

* For description, with colours of "Lice," or early condition; pupæ, that is, when showing wing-cases; and winged specimens, see my 'Report on Injurious Insects for 1885,' p. 16, where I give a special note of specimens sent me from Tabley Grange, Cheshire.

It is necessary to mention this to save confusion, as sometimes the quantity of brown Aphides is so great, as to give the appearance (as noted by one observer) of the ears having the "smut," but from the mixture of colours, and other circumstances, there seems no reason to doubt that these variously coloured Aphides are of one species, and that the different names are to be accepted as synonyms, or at most as indicating slight varieties.

These brown or fawn tints, of course, are totally distinct from the brown or black tints of the Aphides which have been destroyed by the feeding within them of the maggots of the Ichneumon Fly, the *Aphidius avenæ*, figured in previous numbers of these Reports.

The Plant Lice may be found early in the summer on the leaves and stems of the young Corn, and later on they attack the ears. They are of the same shape throughout all their stages, from the time they are hatched, or produced alive, up to maturity, excepting that (at maturity) a portion are winged, and these in their immediately preceding state have wing-cases. But in the important point practically, that they all live by suction throughout their whole life, and also have power of walking (up to the date of also flying), they are alike in all their stages.

These Aphides infest Wheat, Oats, and Rye, and, to a lesser degree, Barley, as well as many of our commonest Grasses. How far propagation and feeding may take place in this country during winter under ground near the food-plants, or above ground in their shelter, does not appear to be at present known.

As last year's attack was so prejudicial, it seems desirable to record it, and to give a few notes received; but except showing the great prevalence at various localities, and likewise that the infestation was noticeably in most instances of the brown-tinted Aphides, and also that some of the notes confirm previous observations of the attack being most severe to the late Wheats, little special information has been contributed beyond what we previously possessed.

On the 19th of July, Mr. Alfred Blomfield, writing from Orange Hall, Gosfield, near Halstead, Essex, forwarded me some ears of Wheat badly infested with Corn Aphides, in this instance mostly brown in colour, with the following note showing the prevalence of attack in that neighbourhood:—"I am sending you by same post two or three ears of Wheat, and should be glad if you would let me know your opinion of them. I find that most of the Wheats in this neighbourhood are similarly affected."

A little later on the following communication was forwarded to me from Mr. E. J. Bishop, of Budnall Thame, by the Editor of the 'Farmer and Stockbreeder' (see No. for Aug. 1st, from which, by permission, I reprint the inquiry, together with my reply). It will be

seen that Mr. Bishop alludes to the brown fly being more numerous than the green kind, and also that the infestation was chiefly in the most backward ears:—

“The Grain Fly.—For many years I have carefully watched the Wheat crop at this important period, but yesterday (July 21st) I discovered what I have never noticed before, namely, large numbers of the green fly which usually attacks Roses, and still larger numbers of a brownish fly somewhat similar, but rather larger, which I found in between the meshes of the Wheat ear. I find the same thing more or less in all my Wheat fields, but chiefly in most backward ears, where the Wheat has tilled. I should be glad to know if any of your correspondents have noticed anything of the kind, and what effect it is likely to have on the yield? Certainly not a good one.”—(E. J. B.)

To this I forwarded the following reply:—The insects observed by your correspondent as infesting his Wheat, and of which you send me specimens, are the “Grain Aphis,” sometimes known as the “Dolphin,” or “Plant Louse.” The green kind is *Siphonophora (Aphis) granaria*; the brown kind has been named *Aphis avenæ*, or “Oat Aphis,” but it is very doubtful whether it is not *only* a variety of the Wheat Aphis. The infestation is rather prevalent this year. The Aphides do mischief by piercing into the tender parts of the ear with their suckers, and withdrawing the juices, and they cause injury at the same time, by the innumerable small punctures of their suckers into the tender tissues. They multiply with very great rapidity, and (excepting in the full-grown Aphides, being in some conditions furnished with wings) they are nearly alike in all their stages.

The amount of damage depends on the number of the Aphides present, or the stage at which the ear is attacked. Sometimes the ear is almost black with them; but, generally, if attack does not come in great quantity until the ear is just turning, little harm is done. Then the tissues harden so rapidly that the Aphis, or “Plant Louse,” cannot drive its sucker in, and so does no harm.

The only year in which I have had notes of this attack being remarkably prevalent was in 1885, when I had reports of presence from various localities—from Fife, in Scotland, down to Kent, but chiefly from the district across England, from Cheshire to Lincolnshire.

Various kinds of dressings have been suggested as being possibly of service, and in the early stage, whilst the plant lice are still only on the leaves, they might perhaps be of use. But when the Wheat ears are formed, and infested, I should greatly fear, myself, that any attempt to apply insecticides would only risk further loss by injury in passing amongst the plants, and be of no practical service.”—E. A. O.

Specimens of Wheat ears severely infested by Aphides, mostly

brown in colour, were sent me on the part of Mr. George Eve, of Fox Hall, Corbet's Tay, near Romford, Essex, on July 25th, with the statement:—"Mr. George Eve has wished me to send you some ears of Wheat grown on a farm he holds in the parish of Rainham, Essex, about a mile and a half from above address. You will see they are covered with what seem to us Aphides; the whole field, and another near it, are in the same condition. Will you kindly say if the Wheat will be injured by them, and also if such a blight is usual, as it is a quite unknown condition to the farmers in this neighbourhood."—(F. A. Eve).

On the 26th of July, the following note regarding appearance of Corn Aphides, together with specimens of Wheat Aphis, was sent me from Henley-on-Thames, by Mr. Charles Simmons, of the firm of Messrs. Simmons, Land Agents, &c., which well describes the method of attack and its effects:—"I have observed within the last few days that some of the late crops of Wheat on my own, and other farms in the locality, are infested with a kind of green and brown lice. The little vermin stick in the ear between the grains of Corn, and appear to be sucking all the juices which should go to nourish the grain, as the ear soon begins to look withered."—(C. S.)

The following observation regarding Aphides from Oats, as well as Wheat, was sent me, on the 29th of July, from Sunnyfield, near Braintree, Essex, by Mr. D. Radford Sharpe. The specimens of Aphides accompanying were all more or less of different shades of brown or red-brown, thus agreeing (in absence of green colouring) with the kind known by the name of *Aphis avenæ*, Fab. Mr. Radford Sharpe observed:—

"I send you herewith some specimens of what I believe to be the 'Corn Aphis.' They are taken from Oats, as well as from Wheat. The pest is pretty general in this neighbourhood, and it is feared will do considerable damage to the crop. I have noticed that in the Oats the weakest plants are most attacked, and I am told that the autumn-sown Wheats do not show the pest so frequently as the spring-sown samples, thus confirming your remark."—(D. R. S.)

Mr. R. Sharpe's observation refers to notes in my 'Manual,' p. 64, regarding Wheats that have been well advanced escaping effects of Aphis attack better than those of which the ears were still in a condition to allow of being pierced by the sucker of the insects.

In a note sent me in 1879 regarding extremely bad attack of Aphis on 110 acres of Wheat in Cheshire, which was March sown, and later in growth than in average seasons, it was mentioned that in September every *green* head in the field was blasted by these Plant Lice and other observations are given ('Manual,' pp. 63 and 64) regarding early Wheats escaping best, consequently on the self-protection of the drier tissues.

PREVENTION AND REMEDIES.—As the Aphides must exist somewhere or other during the winter, either alive or in egg condition, and it is presumable that a large proportion of the presence would be on or about their food-plants, it could hardly fail to be beneficial to destroy these lurking-places, as far as possible. Thus, clearing wild Grasses round the borders of fields, and also gathering and burning lumps of Corn stubble, might be expected to lessen recurrence of the infestation.

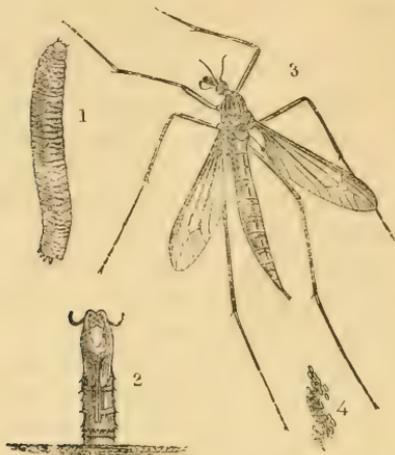
It certainly does not seem reasonably possible to do anything by way of remedy when the attack is established on the ears of Corn, which is the first time when it is usually noticed. The only helpers then are to be found in the *truly* insectivorous birds. The Swallows and the Martins, floating to and fro, may be expected to do good service in this way; but where their nests have been harried in spring by the Sparrows, and where these birds (*Passer domesticus*) are taking their autumn trip into the Corn fields, and, so far as in them lies driving away our feathered helpers, helping themselves as the Corn suits them to *it*, but not to the Plant Lice, all is certainly not well.

It is very unlikely, also, that with an infestation of this kind, which only comes so rarely to a serious extent, that, as will be seen in the above notes, it is in some places almost unknown, that anything will be done in the way of prevention by date of sowing. There is, however, a possibility that with the recent introduction of serviceable insecticide washes and sprayers, something might be done in the earlier stages of the attack by those who were on the alert.

The Aphis is to be found early in the summer sucking the juices away from the stems or leaves of the young plants. It may be, of Wheat, or Oats, or Barley, or Rye, and it is large enough to be found by moderately careful search. Later on it infests the ears. But whilst the plant is still so low as to permit the passage of horse sprayers over it, or the carriage of Knapsack sprayers through it, there does not seem to be any reason why the application of soft-soap washes should not be as useful for clearing Corn Aphis, as for Hop Aphis, or Aphis on Cabbage and Turnip crops running up for seed.

Observations on these applications and implements will be found by reference to Index, and of course it is only where infestation threatens to be serious that it is worth while to go to such an expense. But still with an attack of this kind which *cannot* be remedied when it is established in the ear, and which (as it so rarely occurs) it would be unreasonable to make agricultural preparation for beforehand, there seems absolutely no way of meeting the difficulty, except for those personally interested in the success of the crop to keep watch on it at the stage at which remedies *can* be serviceably applied, and then do as circumstances require.

Daddy Longlegs or Crane Fly. *Tipula oleracea*, Linn.



TIPULA OLERACEA.

1, grub ; 2, chrysalis-case standing up in the ground ; 3, fly ; 4, eggs.

Daddy Longlegs grubs are one of our commonest and most injurious crop attacks. They recur more or less every year, and the history of the infestation has been so thoroughly brought forward that it seems almost a waste of space to enter on it again in detail.

Still, as with the Corn Aphis, mentioned in preceding paper, and the Garden Chafer, see pp. 6—9, there has not been an amount of attack which seemed to call for special notice since record of presence in the year 1885. Therefore I give a few of the observations or main points sent me as shortly as possible, as, though the Daddy Longlegs, or Crane Fly, can hardly fail to be familiar to all country residents, it appears that the grub from which it develops is by no means so well known as it ought to be. The points chosen refer mainly to the attack being sometimes very injurious, even immediately after very severe weather, as early in the year as February ; also to the great amount in which the grubs were found at Mangolds after pasture land, even though this had been dressed with salt, and well cultivated so as to stir the soil to a depth of fourteen inches ; and also at Oats after Clover and ley ; and to grubs being found in numbers of six to a square yard, to five or six in a foot. Also notes of the grubs lying two, four, or six inches beneath the surface ; and one observation of their lying just below the surface by day, and coming on the surface by night : and likewise of the attacked plants being cut through a little beneath the surface, in some instances the portion of the field attacked being laid completely bare.

The first observation was sent me from Stafford, on Feb. 19th (this

being only three days after the remarkably cold night of Tuesday, the 16th), and was accompanied by specimens of Daddy Longlegs grubs, and of the "Surface" caterpillar of the Great Yellow Underwing Moth, of which also large numbers were destroying a Wheat field in the neighbourhood.

The next observation was sent me on the 5th of May, from The Meadows, Battle, Sussex, by Mr. H. T. Simmons, and this I give in detail, as it shows the difficulty, even by deep and careful cultivation, of so clearing infested pasture land as to make the ground safe for the following crop.

Mr. Simmons wrote:—"I am enclosing you some black grubs which I find in large quantities (six in a square yard) in a field drilled with Mangolds. The field was an old pasture field.

"Before ploughing I broadcasted 5 cwt. salt per acre, it was then ploughed with an American digger, with the skim-coulter on, a sub-soil ran behind, making 14 inches soil moved, 8 in the plough, and 6 in the sub-soil. With the Mangold seed I drilled 3 cwt. Rape dust and 3 cwt. superphosphate per acre; a good tilth was made, and rolled down firmly.

"I found this morning the seed just starting, and these grubs in great numbers, mostly in the drill, where I imagine they are attracted by the Rape dust."—(H. T. S.)

Various other communications noted some special point of habits, or amount of attack, amongst the enquiries sent.

From Craven Arms, Shropshire, June 2nd, the grubs were noted as doing considerable damage to a field of Turnips, the grubs being observed to burrow lightly under the soil during the day, but at night to come up and crawl on the surface. (Where this is observed to happen it may be utilized well by rolling, before the grubs go down again.—Ed.) In this case soot, at the rate of $3\frac{1}{2}$ cwt. per acre, was applied without appreciable results.

From Northallerton, Yorks, on June 6th, the Daddy Longlegs flies were reported as being "in myriads," and the larvæ as causing great havoc in two large fields of Oats on the farm of the writer, and also in the surrounding country. Such of the larvæ as had been seen were apparently full-grown.

From Abergele, N. Wales, on June 8th, grubs destroying a young Oat crop were noted at a depth of about two inches below the surface.

From Matlock, Derbyshire, on June 11th, specimens were sent from an Oatfield belonging to the reporter, which had been laid down to Clover for four or five years, and had been ploughed up about the 10th or 12th of March. "In this field these grubs have taken off the Oats to the extent of 4 or 5 acres, and made the ground as bare as a fallow field." The same observer notes the Daddy Longlegs grubs as having

been also very destructive in his large kitchen garden, especially to Peas and Strawberry plants.

From Melton Mowbray, Leicestershire, on June 15th, in bad attack on Barley; the stems were eaten through about an inch below the surface of the ground; as many as five or six grubs were to be found in a foot space; and about half the field was eaten as completely bare as it was before the Barley was put in.

From near Rathmew, Co. Wicklow, Ireland, on June 16th and 20th, notes were sent of such bad infestation (and consequent injury) in some Oats, that on stirring the surface, "any amount of the worms" might be found. In this case, on special examination, the grubs were found from 4 to 6 inches below the surface.

The fly (figured at p. 46) is too well known to need description.

The grub may be familiarly described as in shape not at all unlike a short length of slate pencil, which has been rounded by use to a blunt point at one end, and at the other is still cut or broken fairly straight across. More precisely described, they are cylindrical, legless, about an inch, to an inch and a half in length, when full-grown; wrinkled across, and with four tubercles above, and two below at the truncate end of the tail. They have little black horny heads, furnished with a pair of jaws. The colour varies much according to the land in which they feed, but may usually be some shade of brown or grey, and they may be found at work below the surface of the ground all through the warm part of the year; and according to weather as late in the year as December, or as early as February.

The grubs change to chrysalis state under some protection, as earth or weeds, and when the time is near for emergence of the fly, they may be found (as figured) set upright, about half out of the ground.

The great time for the appearance of flies, and also for egg-laying, is towards autumn. The eggs are small, black, and shiny, almost like grains of gunpowder, and very numerous; one female may lay as many as three hundred. They are deposited on, or in the ground, or on, or under damp Grass and leafage on the surface of the ground.

The favourite resorts of the flies are damp or neglected Grass, marshy ground, Clover leas, meadows, and like localities, and consequently it is to crops put in, after breaking up Grass and Clover, that the grubs (which have remained alive in the soil) are the most destructive. There would have been as many grubs at work if the meadow or Clover had not been broken up, but there would have been a much larger supply of plants for them to feed on, and the important destruction would, in most cases, have been much less.

There are several kinds of *Tipula* flies, but the *T. oleracea*, commonly known as the "Daddy Longlegs," and the *T. maculosa*, or

“Spotted Crane Fly,” a smaller fly of a yellow colour, spotted with black, are the two commonest kinds.

PREVENTION AND REMEDIES.—It may not be out of place to suggest that one most excellent way of lessening the amount of this infestation, of which the history, and circumstances which lead to its presence are thoroughly well known by all who have anything to call a sound acquaintance with the habits of our crop pests, would be for the local teachers under the present arrangements for agricultural instruction to make this information plainly and demonstrably known to their farm pupils.

Probably (under whatever name he may know it) every boy in a village school, and every man or lad on the farms, knows the Daddy Longlegs fly perfectly well by sight; but the enquiries that occur yearly show that its destructive grubs are much less known than is desirable, and to impart information intelligibly, in any district, showing how the presence of the fly and the grubs are connected, and how, though the attack is very difficult to remedy, yet it is open to preventive measures beforehand, would be a very practically useful work.

The points of prevention turn firstly, on making ground unsuitable for egg-laying, or destroying the eggs, or young grubs, before the land is broken up. Such measures as rough mowing and burning the rubbish; brush harrowing; hand-feeding sheep on the land to be broken up (an especially good preventive if done early enough in the autumn); or again, strong dressings of chemicals, as salt, or gas-lime, which would kill not only the grubs near the surface, but would also so poison the Grass, that it would destroy this both as food and shelter, are examples of various kinds of serviceable preventive treatment.

In the case of the heavy chemical manuring, the land must of course lie a few weeks untouched, that the applications may wash down and become diluted to a safe strength, or, in the case of gas-lime, may have gone through the requisite changes to form a serviceable manure, before breaking up. Farm manure, on the contrary, would be anything but a *deterrent* autumn dressing. The flies would in no way object to its moist shelter above their eggs.

Where labour can be spared, paring the lea lightly early in autumn, and collecting and burning the parings is a great preventive of infestation. This presents a bare surface, instead of the requisite grassy shelters for egg-laying, and also if the surface is already infested the eggs and young grubs are thus collected and destroyed. In dealing with this attack, bad as it is, still we have not the trouble to meet that there is in the case of Wireworms, or of Cockchafer grubs, which live for several years in the infested ground, and which may in

some cases probably, in some certainly, lie quite below the mere surface position of the autumn eggs or newly-hatched grubs of the Daddy Longlegs. When the grubs are near full growth they can go down to a considerable depth, as noted at p. 48, where they are mentioned as lying from four to six inches below the surface, and it is the power of boring in the land which this shows, that makes it so desirable to be on the alert to check attack at the very beginning, and so difficult to deal with it afterwards.

In ploughing, such working as presses the furrows together, and turns the sod over smaller and lighter for the harrows to break over, is much better than where the furrows are turned so as to afford a shelter to the grub.

Observations on this head are, however, given in my Ninth Report; and in the two preceding Reports many details are given of Daddy Longlegs attack, and methods of treatment, which it is unnecessary to repeat here, as the main points up to date have also been given in my 'Manual,' 2nd Edition, and recently in my 'Text-book of Agriculture.'

But the results of all the observations (stated shortly) show the great importance of *prevention*; of forestalling attack by all the means in our power, which will prevent egg-laying; or give no food for the grubs; or destroy them when still near the surface. Also such preparation of the land as will give a good seed-bed, and encourage a rapid and healthy growth, but bearing in mind (so far as attention can be given to the fact) that Daddy Longlegs grubs can make themselves perfectly at home in farm manure beneath the plants, and have been recorded as carried out in it to the field.

All measures of remedy when the attack is set up, such as hand- and horse-hoeing, rolling, hand-picking, and the like, are a quite certain addition to expense, and not all certain cures, though often palliatives; and the most hopeful applications in an infested growing crop appear to be chemical manures, which will be obnoxious to the grub, and push on such a hearty growth, that so much of the crop as is not killed may fairly make up for the loss of the rest.

Of these, nitrate of soda is very obnoxious to the grub (where it reaches it), and is good for the plant; guano and salt mixed, at the rate of 4 cwt. the acre, have been found exceedingly useful in bringing a failing Corn crop well over attack. Also a mixture of guano $1\frac{1}{2}$ cwt., kainite and superphosphate each 1 cwt., and salt 2 cwt. per acre, applied to a twenty-acre field of Oats after Clover did well,—in the words of the owner, "We have the crop restored, *minus* the cost of manures." In this case manures, labour, &c., of which details were sent, amounted to £31; and these additional outlays (especially where they are simply money thrown away) are a most objectionable increase of cost of production of the crop, where circumstances

would have allowed of its safety, by use of autumn measures of prevention.

Frit Fly. *Oscinis frit*, L. ; ? *Oscinis vastator*, Curtis.



OSCINIS VASTATOR.

Frit Fly, nat. size and mag. ; maggot and chrysalis, magnified, nat. length respectively an eighth and somewhat over the eighth of an inch.

The injury which the Frit Fly causes in this country is usually by means of its small whitish, legless maggot living in the heart of the young Oat plants in spring, or early summer, and thus destroying the shoot in which it feeds, by eating out the centre. It is an attack that is very rarely reported at all, and it has been only once (namely, in the year 1888) that observations have been sent in of the infestation doing really serious and widespread mischief. In that year the attack was especially bad in the south-west of England in various districts, from Taunton, in Somerset, to the extreme west of Cornwall, and was reported also from various other localities, ranging across England, as Cirencester, Reading, Tetsworth, and other places. But the matter of special interest regarding this attack, which we have only been able to complete the investigation of in this past summer, is to learn how many broods the insect has, or can have, in this country, and where they are to be found.

In the samples of spring or early summer form of attack sent me, the maggots which had ruined the plants might be found turning to little brown oval chrysalids towards the end of June, and the fly was appearing, also from attacked Oat plants, about the 17th of July. But it was not to be supposed that these little bright black, shining, two-winged flies, hardly the eighth of an inch in length, lived on to infest the spring Oats of the following year, more especially as we know that

on the Continent of Europe the summer brood was to be found feeding in Barley ears, and amongst grain in the Oat heads.

It has not been, however, until this year that I was able to trace the matter clearly home to development of specimens of the Frit Fly in the summer or autumn Oat heads from information placed in my hands, with samples accompanying, by the Editor of the 'London Corn Circular' (see p. 1 of No. for Aug. 29th, 1892). During August, the Mid-Surrey correspondent of the above-named paper had complained much of blight and rust in the Wheats, and also of damage to the Oat crop in his district, and a bundle of samples of injured Corn was sent to me for examination, and report to the 'Corn Circular.'

Of these specimens, forwarded to me on the part of Mr. Main, of Madox Farm, Bookham, I found the Wheat to be most seriously attacked by what is commonly known as rust, or mildew, and as I did not find insect presence, or sign of insect presence, having been in the ears of Wheat, it appeared this part of the crop mischief was attributable to the fungoid attack, on which, however, it was not my place to speak.

With regard to the Oat plants, I did not find any fungus present on the stems, but many of the Oat grains were small or distorted, and in the packet I found a few small, but excessively active, two-winged black flies. These I gave such information about as could be gathered (without delay) from the specimens sent, also mentioning that the name of "Frit" Fly (mentioned in former days by Linnæus) was given to the infestation, from the number of worthless grains, known as "frits," which are caused by the gnawing and feeding of the maggots. This was on the 20th of August.

I was, however, somewhat in difficulties as to absolutely certain knowledge of the feeding ground of this infestation (*i. e.*, whether it had been certainly on the Oats), all the Corn having come in one bundle; therefore as the matter was of much interest, being, I believe, a new observation in this country, I separated the Oat heads from the rest of the Corn, secured them carefully, and after watching a few days, forwarded, on the 24th of August, the following report to the Editor of the 'Corn Circular':—

"Since writing to you on the 20th inst. regarding specimens of infested Oats placed by you in my hands, I have been continuing my observations carefully, and now give you the results somewhat in detail, as I think the presence of 'Frit Fly' in Oat heads, though probably not a serious matter in this country, still is of some practical importance. To make sure of the flies being out of the Oat heads, and from nowhere else, I placed a good number of the heads in a large glass bottle (carefully secured), with the result that on the following day and since the flies have continued to appear. These agree in all

points which I see with the description of the 'Frit Fly' (*Oscinis frit*), and I have also found the very peculiar chrysalis. The flies are very small, less than the eighth of an inch in length, but are observable from their habit of dancing or skipping about, as if taking short jumps. They are of a very shiny black, lighter beneath the abdomen, and the head has a very shiny black patch on the crown, the feet are more or less yellowish or brownish, the two wings are whitish, the club-shaped 'poisers' (placed behind the wings) yellow whilst the insect is still alive. The chestnut-brown chrysalis is (like the fly) very minute, cylindrical in shape, diminishing to the two extremities; at the tail end it is furnished with two spiracles, projecting so much as to give the appearance of the tail being cleft. Just behind the head are a pair of stalked and branched spiracles, and at this extremity there are some spots of somewhat starlike markings formed of minute dark lines radiating from centres. We are rarely (so far as we know) troubled by this attack in its summer form in our Oat heads or Barley ears, but it is, as I mentioned in my previous letter, sometimes exceedingly injurious on the Continent of Europe. In 1888 the infestation did great harm here in the young Oat plants, at localities mainly in Cornwall and N. and S. Devon, of which I gave a detailed account in my 12th Annual Report. This was by the small maggot feeding (in the same manner as the Wheat-bulb Maggot) in the centre of the young growing plant, but I have heard little of the infestation before or since. So much of the Oat crop being sown either in spring or late winter is a great safety against this attack, as where this date of sowing occurs, the young plant is safe from attack of the flies which are about in the autumn. With regard to spring sown Oats, the earlier these can be put in the more likely they will be either to escape attack from flies (developing from chrysalids in which they have passed the winter), or (in case the plants are attacked) their more established growth will help them to bear it better. But though well to be on the watch, this is not an infestation which appears likely to be of frequent occurrence here."—(E. A. O.)*

On examining the Oat specimens from Bookham again on the 14th of November whilst preparing this paper, I found a good many more of the little black flies had developed, and were lying dead amongst the dried Oat heads.

On the 6th of June the following communication as to damage by "Frit" maggots was sent me by Mr. D. D. Gibb, from the Ossemsley Manor Farm, Lymington, Hants, but excepting this, which will be seen to mention great amount of infestation, I received very little communication as to presence of this attack.

* See 'The London Corn Circular,' Aug. 29th, 1892, p. 1.

Mr. Gibb wrote :—“ A great many of the common farm pests have shown themselves again this spring, but (except in the case of Frit Fly, which did great hurt during the dry spell about six weeks ago, when I counted in different places from 20 to 40 plants of Oats destroyed per square yard) recent rains have now greatly effaced this damage.”

The figures at p. 51 give a good idea of the appearance of the maggot and chrysalis-case when moderately magnified. When much magnified it can be seen that the maggot has a branched spiracle on each side near the head, and at the tail it has two projecting wart-like spiracles. When the *puparium*, or chrysalis-case is still newly formed, the branched spiracle near the head end is still very observable when magnified. The two wart-like spiracles at the tail extremity are slightly indicated in the figures, both of maggot and chrysalis.

In this country we have now found that the three successive generations of the fly, namely, early summer, late summer (in the Oat heads), and autumn or winter again (like the first attack of the year in the young plants), are, or may be, present, though the two latter appear practically, as Corn pests, of little account. But what this attack is in favourable circumstances is excellently given by Dr. J. Ritzema Bos, Prof. at the Royal Agricultural College, Wageningen, Netherlands,* in great detail in his observations, published in the course of last year (1891), and from them I extract some points which may help us both in our investigation, and in practical treatment.

“ The Frit Fly has commonly three generations in the course of the year, and the maggots live according to the time of year in the lower or higher part of the stem, or in the not yet entirely developed ears of graminaceous plants,—in wild or pasture grasses, as well as in cultivated kinds of Corn.” . . . “ The Frit Flies pass the winter in pupal state.” . . . “ From the hibernated pupæ the Frit Flies usually develop at the end of April. They then infest, in their skipping or dance-like flight, both various kinds of grasses, and the summer Corn (summer Rye, summer Wheat, Barley, and Oats). It is necessary, however, that the Corn should not be far advanced in its growth; the stem must still be entirely hidden in the leaf sheaths, and also must still be exceedingly small.”—(J. R. B.)

The above extracts carry us forward to the conditions of which we know the history only too well here. We find (when attack is troubling us) that the Oat plants during June show signs of mischief within, and on examination the white Frit maggot is found to have destroyed the centre of the shoot. According to date it may be lying there as a

* See ‘Tierische Schädlinge und Nutzlinge,’ von Dr. J. Ritzema Bos, p. 29, Berlin, 1891. I give the quotations in translation.—Ed.

maggot, or lying as a little brown chrysalis, often in the outside leaves, and during July the Frit Fly comes out from the chrysalids. So far as I find from the reports sent me in 1888, the year of really serious Frit infestation, the dates run thus,—attack observed towards the latter part of June (though maggots were still to be found in July); chrysalids to be found at the end of June and in July, and the flies first recorded as beginning to appear about July 9th.*

Now, bearing in mind that dates of infestation vary much according to circumstances, of climate, &c., if we turn to the minute details of Dr. Ritzema Bos, we find this passage:—"In the spring attacked Oat or other Corn plants, we find the maggots in May, in the last days of this month, or in the beginning of June the pupæ; in the middle of June we find the complete insect."—J. R. B. Thus our first infestation ranging from June to the middle of July, runs about a month later than the Continental attack, dating from May to the middle of June, a matter which may tell materially on prevention of a second brood where the Corn has passed the early blossoming stage, or *state of ear preceding the development of the blossom*, before the chief amount of the summer brood of Frit Flies have come out to lay on it in the soft condition in which alone it is suitable for their use.

Quoting again from Dr. Ritzema Bos:—"These flies skipping about in June lay their eggs afresh, either on the leaves of grasses, or on the still very young blossoming, or as yet not blossoming ears of various kinds of Corn, never in ears which are quite out of blossom." . . . "The maggots develop quickly (in three weeks), and after short duration of the chrysalis state the flies appear in August, September, or October, and lay their eggs in the winter Corn or Grasses. The damage caused by the maggots to the winter Corn is scarcely distinguishable from that which their progeny gives rise to in the summer Corn."—J. R. B.

Here we have the records of three generations, as a regular thing, and, with us, by careful observation, we have secured record that we *can* have this amount, namely, spring, summer, and autumn brood, here; but, so far as we see, the spring attack is rarely serious, and the others quite exceptional.

Last season has given us an observation of Frit attack being found in the growing Oat heads in August; and that we are not wholly without the autumn or winter attack is shown by the observation with specimens accompanying, sent me in Nov., 1889 (and noted in my 'Annual Report' for that year). These plants were sent me from Wylie, near Bath; they were about two to three inches high, with the

* See paper on "Frit Fly," pp. 34—43, of my 'Twelfth Report on Injurious Insects.'—Ed.

maggot lying within. The specimens were received on the 12th of November.

Looking now over the whole history of this Frit infestation, it appears to me that our *customary* agricultural treatment is a great safeguard against anything like *customary* attack.

The fly *can* infest common Grasses and Corn crops, but as a matter of preference it takes Oats and Barley, and with us (although in the year of bad attack (1888), I had the opportunity of examining many samples of infested plants), I have no personal knowledge of it having been found infesting other crops than Oats; and also had detailed information from two careful observers (one in Cornwall, and one near Tetsworth) of the marked preference of the Frit Fly for Oats over Barley, even when the two crops were sown together, as with "dredge Corn" (in this case Barley and Oats mixed); or, in another case, where part of the field was in Oats, and the other part in Barley.

Going on now to cultivation,—with regard to time of Oat sowing. In the 'Elements of Agriculture' (the Royal Agricultural Society's Text-book on this subject, prepared by Dr. W. Fream), p. 241, we find, "Oats as a Corn crop are almost always sown in the spring, but in a few light land districts they are popular as an autumn sown crop." Also in the table at p. 256, the time of sowing is given as "February to April; occasionally in autumn, when the winter variety is sown."

It is obvious that where winter Oats are not sown, the Frit Flies that may be about in autumn do not find their favourite egg-laying plant. They may deposit on wild Grasses or cereals sufficiently to keep the breed from dying out, and they probably do, but there are not great nurseries of infestation in which chrysalids can spend the winter to give us out flies in April.

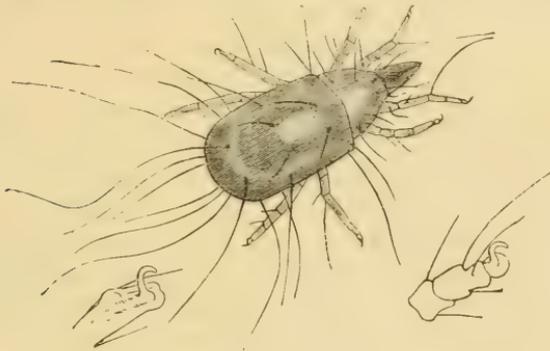
Injury, however, from this third brood of the year appears to be very little noticed any more than that of the second, or summer brood, in the Oat heads; and so long as (from whatever cause) there is no appreciable amount of this second attack to supply flies for autumn laying, and as a general thing the special crop for the use of such as may come is not sown until February or later, there does not seem to me to be reason to fear any really general attack. Still, as when from some unknown cause the infestation appeared in Devon and Cornwall, and some other scattered localities in 1888 and 1889, it showed a power for mischief which called for care and thorough knowledge of its habits; it has seemed worth while to keep careful watch till we could make out and record its full history.

For preventive measures against an uncertain attack it is hardly possible to give up time and trouble for special arrangements which very likely may never be needed. But where there is reasonable cause for expecting it in the spring Oats, it is well to remember that those

which have been sown the earliest have been found to do best. On the contrary, those in the same locality, sown as late as April, have suffered greatly. Being young and tender at the time of attack of the fly, they were much more open to injury.

Also if attack is noticed at a very early stage, there may be some benefit from giving fertilizing dressings, but there is a great risk at best, of the young shoots pushed on by these giving a crop of uneven date of ripening. For notes on these points, see my 12th and 13th Reports before referred to.

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



TYROGLYPHUS LONGIOR.

T. longior, from figure by Fumoze and Robin; claw with sucker of *Tyroglyphus*; right-hand side, from Murray's 'Aptera'; left-hand side, figured by Ed. from life: all magnified.

The minute "Hay Mites," of which each Mite is so small in itself that they are scarcely observable, excepting in the great masses in which they may be found round infested stacks, or where they have fallen from infested haylofts, have again been enquired about, from a few new localities, in the past season.

These *Acari* differ very little from the common Cheese Mites, in nature as well as appearance, but under a powerful magnifying-glass they are distinguishable, as shown in the above figure, by the much greater length of the hairs.

For several years back they have been reported occasionally as being found in great quantities, dropping "by shovelfuls" from infested stacks or lofts, or lying an inch or more deep round stacks, or the hay itself being alive with them. Also (and naturally) those not acquainted with the infestation are apt to feel not a little anxious as to what the effect of these living dust-like masses, or the same creatures pervading the whole of a hay or cloverstack, may be on the stock fed

with the fodder. And though in this respect the infestation has been found not to be injurious, still it is troublesome and undesirable; and such amount of information as the observations which have been sent furnish towards the history of the objectionable presence is of some interest.

The Mites have been sent from one or two localities in Ireland; a few in England; but, for the most part, the observations have been sent from Scotland; and it is observable that these localities are often at or near the sea coast.—This may of course be only a coincidence; still we have notes of them from a locality in Berwickshire; from Skene, in Aberdeenshire; Garve, not far from Cromarty Firth, on the east of Ross-shire; and the infestation is specially noted from the Isle of Jura, and as having been observed there more than twenty-five years ago; and in England notes have been sent, besides other localities, of presence near Swaffham, Norfolk, and Bury St. Edmunds, Suffolk.

The earliest date of observation of Mite presence appears to be when the large “cocks,” or “tramps” (in which it is customary to collect the hay on the field, as soon after cutting as possible, in the West Highlands of Scotland), are moved for carrying. Then,—as reported to me by Mr. Thos. Fraser, Ardfin, Isle of Jura, N.B.,*—“The first appearances of the Mites (to an ordinary observer) are when removing the said cocks, or tramps, from the field. While forking the hay from the bottom or lower part of the cock on to a cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and from the backward position of the worker’s head at the time, they stick and adhere to the face in a very short time, causing itchiness or irritation on the skin. At this stage, I think, they are less in size than they are when found a fortnight or so later on emerging from the recently made stacks.”—(T. F.)

This stage of emergence is that in which the Mites are usually reported, and they have become so exceedingly noticeable that information as to their nature is desired. I have had them sent on the 15th of Sept., as dropping from the haystack observed; at the beginning of October as dropping in vast numbers from hay in a loft, and as late as the middle of November, specimens, both Scotch and Irish, have been sent me from infested haystacks.

In the past season the first communication of observation of these Mites escaping in great quantities from an infested haystack was sent me on the 25th of August from Westacre, Swaffham, Norfolk, by Mr. Thomas Fryer:—

“I beg to send for your inspection a sample of ‘Mites,’ which, for

* See my ‘Fifteenth Report,’ p. 29.

some days past, have been dropping on the ground in vast quantities from a haystack of this year's hay, got up under unfavourable conditions in wet weather. The Mites lie in masses of many quarts heaped up upon the ground."

Mr. Fryer particularly desired information as to whether this infestation was injurious to stock, or crops, or otherwise hurtful.

At the above date, a communication was also sent me from Risby, Bury St. Edmunds, by Mr. G. J. Paine, regarding enormous presence of these creatures which were then making their appearance from the stack of Clover *saved for seed*, of which observations have been given in the foregoing notes, pp. 38—40.

Mr. Paine observed:—"My stack is now covered with the small insects which I have sent you by this post." . . . "I could have no difficulty in sending you a peck of them. Will they be detrimental to anything else than the Clover?"

On the 16th of November the following observation, which is of considerable value as confirming the view of the Mites being especially found in hay which had lain in large masses, but *was little heated*, was sent me from Inverbroom House, near Garve, Ross-shire, N.B., by Mr. J. A. Fowler:—

"By this post I send a small box containing some minute insects. I have never seen them before. They came from a haystack; owing to a very wet autumn, I could not get the stack made till late in September. The hay was saved in large rucks in the stackyard, waiting for fine weather to put into a stack, consequently the hay hardly heated at all.

"About a month after the stack was made, we had very severe frosts, 15° Fahr. The following day, on each side of the stack, there was a layer, about 2 in. deep and 6 in. to 8 in. wide, of what was apparently pink sand." . . . "There are still considerable quantities remaining, though it is a month since they first appeared."

Why the Mites come out in these vast quantities towards, or during autumn, we do not know at present. The very important point that no harm is caused to stock, feeding on the Mite-infested hay (excepting sometimes the irritation of the Mites in being swallowed giving rise to cough); has been carefully watched and clearly reported. The following note on the subject was sent me by Mr. Colin Campbell, of Jura, N.B.:—"For the information of your readers I may state that this hay" (*i. e.*, Mite-infested hay) "was fed to a large fold of in-calf Highland cows, young cattle, horses, and dairy stock, without doing them the slightest harm, or producing any ill effects."

Still if we could get rid of the infestation, it would be much better, and any information tending to its prevention, especially as to whether any dressings, such as a good liming of grass-land, had been found

effective, would be a most acceptable contribution. But meanwhile where the pests are found by inches thick round stacks it certainly would be desirable to shovel them up from time to time, and destroy them in whichever of the many ways which might occur at the time to be most convenient.



Of the four following Corn attacks, namely, HESSIAN FLY, GOUT FLY, WHEAT-BULB FLY, and CORN SAWFLY infestations, which, excepting the first named, are often prevalent locally, and sometimes in many districts to a serious extent, very little was reported.

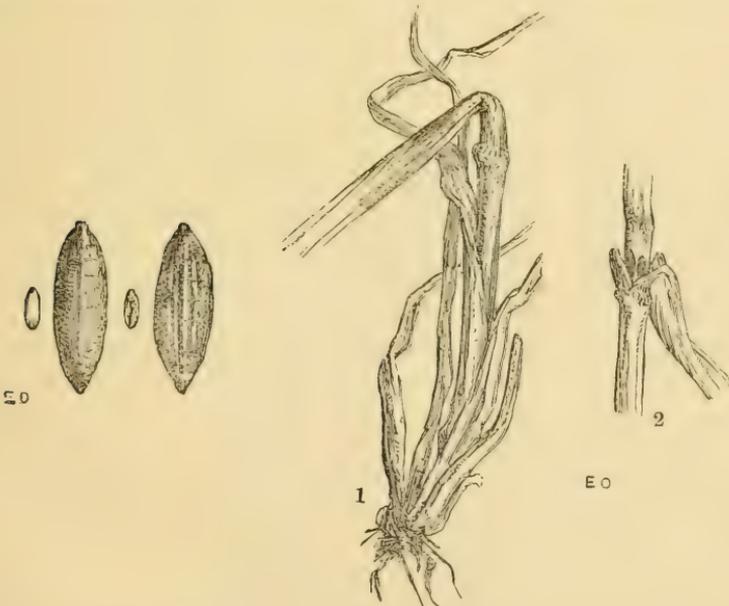
Of the Corn Sawfly, *Cephus pyraeus*, which injures the Corn stalk by feeding within it, ending by so biting it through in a ring at ground level, that presently the severed stem falls: no injuries were reported.

Of "Gout Fly," *Chlorops taniopus*, mention of severe presence of this infestation in some Barley at Holkham, Norfolk, was made by Mr. Davey, on the part of the Earl of Leicester; and also injury to Barley which, from the specimens sent, had been attacked at different stages of growth, was reported from Woodhall, Hertford, by Mr. Noble, on the part of Mr. Abel Smith. This attack is distinguishable when it takes the plant in the early stages by the growth being checked, but at the same time the sheathing-leaves round the attacked embryo ear and its stem being so swelled, as shown in the figure, as to give a swollen or "gouty" appearance to the plant (see fig.). When the attack occurs later on, the ear is damaged in amount according to the date of attack. The plant may then gain nearly its full growth, and the ear may possibly free itself wholly from the swollen

sheathing, and be only moderately injured by the maggot workings. In these conditions the attack is recognizable by the lower part of the ear being injured, and by the blackened furrow which has been gnawed by the maggot down one side of the stalk, from the ear to the first joint. This attack is one of our common and serious Barley infestations.

Of "Wheat-bulb maggot," of *Hylemyia coarctata*, a small two-winged fly, an infestation which has been doing a very serious amount of mischief for some years back, very little also was reported. This infestation is hurtful by the maggots feeding in the heart of the young Wheat (in the same manner as the maggot of the Frit Fly in young Oats, see pp. 51 to 57), the attacks being hardly distinguishable without the help of a good magnifier. This attack of the Wheat-bulb maggot especially occurs on land which has either been fallowed in the previous summer, or where the land has been cleared of crop, or the crop so thin as to expose the land.

Of "Hessian Fly," *Cecidomyia destructor*, very little indeed was said, and nothing of any importance. This attack is distinguishable by the infested Corn stalk, commonly Barley, but sometimes Wheat,



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

being what is called "elbowed" down. The white legless maggot, or maggots, of the Hessian Fly feed by sucking the juices from the stem

a little above a knot of the stalk. This is often the second from the ground, and the stem being weakened at the point of suction, gives way and bends sharply down at an acute angle, thus allowing the ear of Wheat, or Barley, to be injured by lying on the ground, and further damage and difficulty in gathering the crop is caused by the confused state of the straw.

From the experience of the six years since this attack was first known amongst us as a crop pest, there appears every reason to believe that (unless possibly from passing circumstances, such as the unusually high temperature of the summer of 1887), we need not fear it as a generally prevalent and serious infestation, so long as our present methods of autumn cultivation, or rather date of autumn sowing, of Wheat are continued. By this we are spared the mass of attack on the young winter Wheat, by which not only the plant itself is killed, but a winter generation established to set up flies for the summer attack, for which otherwise there would have been an infinitely lesser amount of fly parentage to supply the eggs.

Another point of prevention, so important that I would most earnestly beg the attention of all farmers who wish to save recurrence of attack in case of infestation, to be directed to it, is *that on no account whatever should they allow themselves to be induced to save infested screenings.*

We have found from the beginning of observation of attack, that the little flat brown chrysalids, so like "flax-seeds" (see fig. at p. 61), that they go by this name, are thrown in threshing amongst the siftings, also amongst the light Corn, or, as it is sometimes called, "shag."

In one case the flax-seeds are easily destroyed with the rubbish, in the other are easily so consumed as to be got rid of; but on the destruction of these germs of coming attack rests very greatly our hope of safety in cases of bad infestation.

This matter is one that ought to be carefully attended to, as it is from time to time brought forward, especially by those who have *not* practical knowledge of the agricultural bearing of the case, that, as many of the flax-seeds either are, or very likely are, infested by the maggot of a Parasite Fly, *we ought to save all the flax-seeds!* in order that the parasites which may be in them may hatch out, and go to the fields and infest Hessian Fly maggots.

But it is never mentioned, in this calculation, that before the parasite *can* do this, the Hessian Fly must have been beforehand; the brood out of the saved Hessian Fly chrysalids (which we *could* easily have killed) *must* have caused another attack to our Corn, their maggots done all the usual mischief, and ourselves got no benefit at all, except that we have nursed up a new supply of Hessian Fly chrysalids of which *a portion may be infested by parasites.*

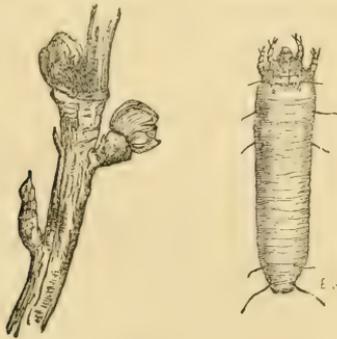
It appears to me that this is how the matter stands, and that it is the most desirable course by far when we have the germs of a future attack in our power (that is to say, find we have enough flax-seeds to trouble ourselves about one way or other in our hands), just quietly to destroy them, and so with absolute certainty prevent them being the cause of another attack, which would not be prevented by the presence of the parasites, whatever these might do when the mischief was complete.

For those who desire the highest entomological opinion on the subject, it may be useful to remark that on this point we have the clearly expressed opinion of Prof. C. V. Riley, Entomologist of the Department of Agriculture of the United States:—"At present, and with general entomological knowledge in its present state, there can be no doubt that it will be advisable to burn, or otherwise destroy screenings, which examination shows to contain puparia. It is a great bother for anyone to breed parasites, and for a practical man it is out of the question."—(See 'Insect Life,' Periodical Bulletin of the U. S. A. Dept. of Agriculture, March, 1889, p. 294.)

The Corn attacks of last season have been peculiar, both as to presence and absence, and it may be conjectured that this latter point, and especially the much lesser amount of inquiry as to infestation in young Corn early in the season, arose from the difficulties in getting the land into cultivation in the preceding autumn.

CURRENT.

Black Currant Gall Mite. *Phytoptus ribis*, Westwood.
(Also *Chalcididae*, genus *Entedon*, in Galls).



PHYTOPTUS? sp.

Phytoptus-infested buds; *Phytoptus*, enormously magnified (life size invisible to the naked eye).

It is now many years since the attacks of the Gall Mites (figured at p. 63), which cause the Black Currant buds to become mere swollen knobs, abortive for all useful purposes, have been a great trouble to Currant growers.

These knobs may be found scattered at distances along an otherwise healthy shoot, or they may occur numerously near together on a shoot of which the regular growth has been checked; they may be merely round swelled growths, or some slight attempt at development of leaf or flower, may have taken place; but even where this is so the diseased buds represent a total loss on them to the grower. The attack is caused by the *Phytoptus*, or Gall Mite, which is as figured (greatly magnified), at p. 63, cylindrical, and furnished throughout its life with two pairs only of legs, placed at the head extremity, which narrows into a bluntly pointed proboscis.

This Mite is to be found in vast numbers within the galls, or knobbed growths, and for this reason breaking off these galls and destroying them as early as possible in the season, so as to get rid of the Mites, and also of their eggs (which I have found with the Mite formed within as early as the 4th of April), is a sure method of lessening amount of coming attack.

Various measures have been tried, such as syringing with soft-soap and sulphur washes, to destroy the Mites that might be straying about the bushes, or sheltered in forks or crannies where the wash would run down and stifle them; also all applications to, or treatment of, the ground which would remove shelters, or destroy Mites harbouring during winter at the surface; and (where attack is noticeable for the first time) the promptest possible measures in totally destroying the attacked boughs, or, if reasonably possible, the attacked bushes, should be carried out at once.

These measures have all been repeatedly entered on, but in the past season the use of Paris-green has been reported to me by Mr. John Biggs, of Laxton, Howden, East Yorkshire, as an application which was of some amount of service joined to dressings of caustic lime on the ground.

Mr. Biggs observed, writing on the 20th of April:—"You will, I am sure, be interested in knowing that I have, to a certain extent, prevented the *Phytoptus* utterly ruining my Black Currant trees. As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I procured from Messrs. Blundell,* and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring I had a boy gathering all the

* Address of the firm is, Messrs. Blundell and Spence, Hull.

little knobs of the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop. Our neighbour's trees, in this village, are utterly ruined, scarcely a leaf to be seen this year, and the trees completely covered with the infected knobs."—(J. B.)

This note may be of some service, as also the observation of Mr. C. D. Wise, sent to me on June 3rd, from the Toddington Fruit Grounds, Winchcomb, Glos., that they had "certainly decreased the trouble" by picking off the buds; but I enter on the *Phytoptus* attack again this year more particularly with regard to identification of two distinct kinds of "co-lodgers" with the *Phytopti* in the galls caused by these Gall Mites.

These are of two orders. We find a *dipterous* larva, that is, the maggot of a two-winged fly (of which we have as yet not reared the perfect insect); and also we find numbers of small hymenopterous flies (that is, little four-winged flies), which, on investigation by a specialist, have proved to be of the parasite family of the *Chalcididae*, genus *Entedon*, but of these we have not yet secured the maggot and chrysalis.

With regard to the two-winged fly maggot, a specimen was sent to myself last year, by Mr. Gibbon, of Seaford Grange, Pershore, which from the disappearance of the *Phytopti*, so carefully secured with it that they could not escape, and other circumstances (given in detail at pages 42 and 43 of my Report for 1891), there appears to me no reason to doubt was feeding on the *Phytopti*. We could not be absolutely certain, as we did not see the fly maggot feeding on the Gall Mites; still all circumstances appeared to point to it, and in the past season, so early as the 14th of March, Mr. Gibbon again found the same kind of maggot in a galled bud.

Being very desirous to secure specimens of the perfect insect, I requested Mr. Gibbon to secure some galls, and let me see what might appear. The result of this was a numerous supply of minute four-winged flies, which last year we advanced so far as to find were Chalcids, and knowing this family to be chiefly parasitic, I ventured to hope that we had secured good allies. On more minute investigation, however, in the course of the present year, it appears that their parasitic habits would be in all probability (or almost certainly directed) *not* against the *Phytopti*, but against their fellow dwellers, and apparent *Phytoptus* destroyers, the fly-maggots, which is somewhat disappointing.

This point being very important, on receipt of a good supply of specimens early in the past summer from Mr. Gibbon, of Seaford Grange, Pershore, I endeavoured to gain further information, and on

application to Mr. E. A. Fitch, of Maldon, Essex (late Hon. Sec. of the Entomological Society), who I was aware had given especial attention to the subject of parasitic Hymenoptera, he wrote me that the little Chalcids were a species of *Entedon*, of which about 165 species were noted as English in the British Museum Catalogues. Under these circumstances Mr. Fitch remarked:—"All I can say is that they are species of *Entedon*, or *Entedonidæ*. These are known parasites of dipterous leaf-miners especially. They are doubtless attached to the dipterous maggots in the Currant buds, in Mr. Gibbon's case, and I think hardly could have been parasitic on the *Phytopti*."

With regard to which division of the Diptera the specimens submitted to me in larval state belonged, I cannot state with certainty, excepting that there was neither distinct head nor any anchor-process visible, and consequently the statement in the elaborate treatise by Mr. L. O. Howard on the *Chalcididæ*, that *Entedon* has been found to be parasitic on *Musca*, may bear on the question.* With regard to possibility of the maggots of these Chalcids feeding within the gall, that is, being *phytophagous*, or vegetable feeders, which is a very important consideration, I find in Mr. L. O. Howard's work above quoted (at p. 586, 20th page of pamphlet), the following sentence concluding some elaborate detailed considerations of the subject:—"Phytophagic *Chalcididæ* are therefore confined to *Isosoma*, and *Isosoma*-like forms among the *Eurytominaæ*." And if we turn now to the "Generic Synopsis" of the 'Classification of Insects' by our own great authority, Prof. Westwood, we find *Isosoma* and *Eurytoma* placed in the Sub-family of *Eurytomides*. *Entedon* is in another Sub-family, that of the *Eulophides*, and consequently it appears clear that these four-winged flies do not add to our troubles by feeding in maggot state on the Currant growths, but are probably feeding on the fly-maggots.

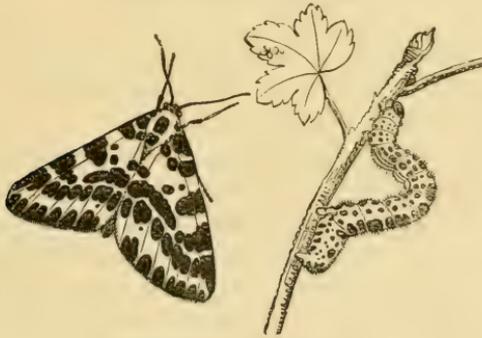
Thus, as far as we see at present, it appears that we should get no good by endeavouring to rear these Chalcid flies. We have no reason to suppose they feed in maggot state on the *Phytopti*, and every reason to suppose they feed on the fly-maggots. The point of their usefulness turns upon what the fly-maggots may be doing. If these fly-maggots are feeding on the *Phytopti*, these numerous Chalcids which destroy our benefactors had certainly best *not* be allowed to develop; that is, when the galls are broken from the Currant shoots, these galls ought to be destroyed. If, on the contrary, the fly-maggots prove to be adding to the mischief by feeding in the galls, and not on the *Phytopti*, the Chalcids would to a certain extent be doing good by destroying them.

* See 'Biology of the Hymenopterous insects of the family *Chalcididæ*,' by L. O. Howard. From Proceedings of United States National Museum, vol. XIV. Washington: Government Printing Office, 1892.

But not so very much, for a bud once galled is very little use, whether or not the mischief caused by a fly-maggot is superadded.

Therefore it would appear desirable to destroy the buds as we are doing now, and also it would be of very serviceable interest if those who have the opportunity would endeavour to rear the fly, and take any other observation with the aid of a strong hand magnifier, such as the excellent glasses of two-inch focus, now easily procurable, and so far as is possible clear up the uncertainty of the matter.

Currant and Gooseberry Moth; Magpie Moth. *Abraxas grossulariata*, Stephens.



ABRAXAS GROSSULARIATA.
Magpie Moth and caterpillar.

On the 20th of May a packet of much gnawed Currant leaves, together with some two dozen to thirty caterpillars of the Magpie Moth, at various stages of growth, from a little over half an inch in length, were forwarded to me by Mr. Edward Tate, from Balcarres Gardens, Colinsburgh, Co. Fife, N.B., with the mention that these were specimens of an attack supposed by the sender to be of the Magpie Moth, *Abraxas grossulariata*, which was then causing great destruction in the cottage gardens in that district, completely stripping the leaves of black, red, and white Currants and Gooseberries.

These larvæ proved characteristic specimens of this handsome looper moth caterpillar. The ground colour yellowish, with a row of transverse squarish dark grey or blackish marks along the back; a row of little black spots along each side, and beneath these a row of larger black markings, beneath these an orange red, or reddish stripe, with again a stripe of black marks lower still along the sides of the caterpillar. Beneath the caterpillars there were also two narrow continuous

black lines. Head and claw-feet black ; the single pair of sucker-feet beneath the abdomen, and the caudal pair of sucker-feet blackish outside.

Besides the orange or reddish stripe along each side, the segment next the head, and the under side of the third and fourth, and also of the four segments at the tail extremity, are of the same reddish colour.

The perfect insect, which in its lightness of make and gay colouring more agrees with the general idea of a butterfly than of a moth, is (typically) marked on both wings with black spots, scattered, or forming interrupted stripes, as figured at p. 67 ; the fore wings with white ground colour, with a yellow or orange blotch at the base, and a band of the same colour across the middle. Ground colour of the hind wings white. Head black, body between the wings and abdomen yellow, the former with one or two black spots, the latter with five rows of black spots, one running along the back, one on each side, and two beneath. It may, however, vary in colouring from being merely marked with a few spots and breaks, or clouds, to both wings being almost entirely clouded with black.

The moths are about from midsummer during the summer months, and the life-history of the insect makes measures of prevention very practicable and simple. The moth eggs soon hatch, and the young caterpillars feed for a few weeks, but the leafage being then strong and plentiful, and the caterpillars small, they do not appear to do much damage, and presently they either spin themselves up for winter in a folded leaf, hung to the bough by spun threads, or winter in the fallen leaves beneath the bushes. When spring and young leafage return, the caterpillars come out again, and feed until towards May or later, when they spin a light cocoon in any convenient place, as on the twigs or palings, or in crevices, and within this they turn to a chrysalis, which is at first yellow, afterwards black with golden coloured rings.

From the above life-history it will be obvious that where attack has been noticed a very little care in winter cultivation will prevent its recurrence. Pruning, and dressing under the bushes should not take place until the time for fall of the leaves is quite past. Then if the bushes are carefully gone over, so as to ascertain that no caterpillar leaf-cradles are left attached to the boughs, and the surface beneath the bushes is lightly skimmed so as to remove the leaves and rubbish lying on the earth, and this collected carefully as the work goes on (not piled in heaps or scattered, but so placed as to insure complete removal), and then destroyed, not merely thrown aside, there will be little fear of attack recurring. *After* this plan has been carried out, then forking, manuring, and all other customary measures of bush-fruit treatment will lessen the likelihood of any caterpillars escaping destruction.

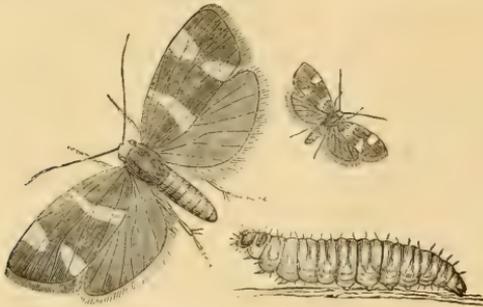
Where bushes grow with several stems so placed as to make lodging nooks for leaves to drift into, or insect vermin to shelter in, it is particularly desirable to clear such hiding places well out.

Should attack, however, occur on the spring leafage, all the usual measures of syringing, shaking down and trampling, dusting, &c., would be available, and as the caterpillars are very noticeable, both from colour and size, hand-picking is also serviceable.

It is somewhat curious, looking at the presence of this Magpie (or Harlequin Moth, as it is sometimes called) being recorded by some of our best writers as "Common everywhere; generally abundant"; "Only too common in all our gardens, both in England and Ireland," that its presence as a seriously injurious attack should so rarely be reported.

The infestation occurs on Gooseberry and Currant leafage, but the caterpillars are especially fond of that of Sloe or Blackthorn; and in 1880, when the attack was widely distributed, I had notes from Sparham, Norfolk, of the caterpillars being common there from the 6th to the 18th of June, but not being injurious, the attack being almost confined to Blackthorn. In the same year, Mr. E. A. Fitch mentioned that at Maldon, Essex, the caterpillars were numerous on Blackthorn at the end of May, and throughout June, and that by the middle of July the moths were very abundant, but though the caterpillars were still plentiful, not a single specimen was to be found on Gooseberry or Currant. In my own observations I have no recollection during a course of many years' residence in W. Gloucestershire, and some time near Isleworth, of seeing the caterpillar attack in the garden, and in both localities there was a great deal of Sloe in the neighbourhood. In case of the infestation being troublesome, the point of whether the Sloe bushes were really the most favourite food would be worth investigation. On these we might use whatever application we preferred without fear of injuring the crop; and the notes sent in from time to time show that thoroughly clearing out the infestation in one year, acts exceedingly in preventing its recurrence.

Currant-shoot and Fruit Moth. *Incurvaria capitella*, Fab.



INCURVARIA CAPITELLA.

Moth, magnified and nat. size from life; caterpillar, magnified, after Stainton.

In 1891, attention was drawn to the mischief caused by this infestation to the young shoots of the Currant. In the past season the careful observations of Dr. Chapman, of Hereford, have shown that the attack is also injurious to the Currant fruit, consequent on the Moth (figured above) depositing her eggs in the Currants whilst still very young. Therefore joining the observations of the two past seasons together, we find that the chief points of the history of the attack may be shortly given as follows.

The moth lays her eggs within the young fruit, and there the larvæ or caterpillars feed awhile, their presence being indicated by a premature appearance of ripening. After a time they creep out of the fruit, and each larva spins a cocoon on the twigs, in which it passes the winter. In the following spring the caterpillar (as yet only partly grown) comes out, and boring into the shoots of the Red Currant in the way previously described (in 1891), destroys the shoot. It then goes into the chrysalis state, from which, in Dr. Chapman's observations, he found moths emerge in time to insert their eggs in the young fruit at dates of from the 17th to the 20th of May.

From these characteristics the name of Currant-shoot and Fruit Moth, might be proposed as being at least descriptive, until a more convenient form may be thought of.

The first appearance in the year of this pest (and the only one in which up to the past season we have known this *Incurvaria* caterpillar as the cause of mischief) is to the young buds, or rather shoots, early in the season. It has been thus noted by various writers:—"The larva is very injurious, eating the pith of the young shoots, and betrays its presence by the withering of the young leaves; when quite young it is dark red, but when full-fed it is greenish white."* Also, "The

* Stainton's 'Tineina,' p. 42.

larvæ (according to Stainton and A. Hartmann, of Munich) live early in May in the young shoots and buds of the *Ribes rubrum*. These they devour even to the pith of the twig." *

In observations sent me in 1891 from the Toddington Fruit Grounds, Winchcombe, Glos., by Mr. C. D. Wise, he mentioned that "about the 20th of April, we noticed numbers of the young shoots of the Red Currant bushes had withered up and drooped. On examination we found in each a small grub which had bored its way up the stem." Specimens of the moth reared from these caterpillars, from one of which the illustration at p. 70 was figured, proved the attack to be of *Incurvaria capitella*. Of this Mr. Wise further remarked, "The moth hatches the end of May and early in June." †

In the present year, that is, 1892, Mr. Wise, writing to me again on the same subject from Toddington, on the 9th of April (that is, eleven days earlier than the date of the observations of the previous year), remarked:—"We have to-day found *Incurvaria capitella* in the shoots of our Red Currants. You will remember last year we did not notice the attack till the 20th of this month. The shoots of the Currants are very small, and I must say I was surprised to find the little caterpillar already there. I suppose the warm weather has hastened the attack. I have started the men to-day syringing with Paris-green, 1 oz. to 10 gallons, and will let you know the result. The caterpillars being so very far in the shoots of the bushes, the difficulty is to get anything to them."—(C. D. W.)

These various notes show the manner in which the attack of the hibernated caterpillars (that is, of the partly grown caterpillars which have passed the winter each in its cocoon on the bushes) is hurtful to the young Currant shoots. And this, excepting the date of appearance of the moths, and the fact of their presence being observable round bushes, which they might be infesting, was, I believe, as far as we had advanced until Dr. Chapman's observations in the course of the past season showed where to look for the eggs, and for the caterpillars hatching from them, by which the infestation of the next generation of this *Incurvaria* attack is commenced in the young Currant fruit.

With this guidance, Mr. Wise followed the matter up for practical use at Toddington, and on the 3rd of June he wrote me:—"The moths have been hatched with us some little time, and are now laying their eggs on the fruit of the Currant. We have also found some of what we believe to be the larvæ feeding on the Currants."—(C. D. W.)

Dr. Chapman's paper includes besides a very clear account of the method of infestation to the Currant fruit, descriptions of the larva and

* 'Pflanzenfeinde,' of Kaltenbach, p. 260.

† 'Fifteenth Report on Injurious Insects,' by Ed., pp. 44, 45.

pupa, and also the reasons (based on some peculiarities of habits and structure) for which he thinks it would be desirable to change the generic name from *Incurvaria*, to *Lampronia*. As, however, this change has only at present been suggested, not adopted, I have retained the name of *Incurvaria*, and refer the reader for full information to Dr. Chapman's paper entitled *Lampronia capitella*, at pp. 297—300, of the No. of the 'Entomologist's Monthly Magazine' for Dec., 1892.

From this, by kind permission of the writer, and also of the Editors of the Magazine, I give the following extracts from the excellently clear account of the method of infestation of the young Currant fruit, and a portion of the description of the larva and pupa. Dr. Chapman commenced the record of his own observations as follows:—

“Certain moths which I reared from the larvæ sent me, paired readily in captivity, and supplying these with a spray of Red Currant, with berries rather more than half-grown, I had the pleasure of seeing the moth lay eggs in such Currants on several occasions. The moths were then sleeved out on growing Currants, and here also they laid eggs, though I did not see it done.” Here Dr. Chapman notes that the apparatus of the moth for penetrating the Currant is a very strong and powerful instrument, and then describes the operation of egg-laying.

“The moth sits upon the Currant, and penetrates it in the lateral region; on one occasion the process occupied three or four minutes, on another only about thirty seconds. The dates were from 17th to 20th May. On examining one of these Currants, which was rather more than half-grown, and with seeds still very soft, but about 1.75 mm. in diameter, two eggs of *capitella* were found lying free in the ovarian cavity, in another the cavity contained two such pairs of eggs.” . . . “I have little doubt, however, that two eggs are laid at each penetration.” The eggs were nearly colourless, and somewhat lemon-shaped, about 0.67 of a millimetre* in length, and 0.37 in breadth.

Continuing Dr. Chapman's account in abstract: no change was noticeable in the Currants under observation until the last week in June, when most of the Currants being still green, some among them had the appearance of being nearly ripe, and these proved to be infested by *capitella*. In some the caterpillar was still present, in others it had escaped, and in two instances Dr. Chapman saw the caterpillar in the act of escaping by boring through the juicy substance of the Currant, and emerging a short way from the summit. “The food of the larva whilst in the Currant is the interior of one seed.” . . . “The buds and fruit spurs of the Currant have at their bases

* A millimetre is one 25th part of an inch.—Ed.

many dead scales that persist from earlier buds, and amongst these the young larva buries and hides itself, spinning a small firm white cocoon, in which to pass the winter."—(T. A. C.)

Detailed description of the caterpillar and chrysalis are given in Dr. Chapman's paper, but for ordinary purposes the knowledge of this being a minute reddish grub, much like other moth caterpillars in shape, that is, furnished with head, claw-feet, and sucker-feet, to be found in the shoots of the Currants in spring, and (noticeably) in the prematurely ripening fruit in summer, appears sufficient. The portion of life-history recorded by Dr. Chapman is so very valuable practically, that I feel greatly obliged, and beg to express my thanks for being allowed to extract so largely from his minute observations.*

The moths (as described in my own Fifteenth Report) are about five-eighths of an inch across in spread of the fore wings; head with a thick tuft of ochrey hair above. Fore wings dark brownish or fuscous, sometimes with a purplish satiny gloss, a pale yellow band across the wing at about one-third of its length from the root, and two patches, also pale yellow, about half-way between the yellow band and the tip of the wing; these two patches are respectively on the fore and hinder edges of the wing, and the hinder patch is somewhat triangular in shape. The hinder wings are pale grey.

PREVENTION AND REMEDIES.—One remedy is obviously to pick off and destroy the infested shoots which have been bored by the little caterpillars which came out from the little white cocoons in which they passed the winter. Thus we get rid of a great quantity of infestation which would very shortly have supplied a new brood of moths to infest the Currant fruit with their eggs, and caterpillars hatched from them. As Mr. Wise remarked, relatively to the infestation at Toddington in 1891:—"The remedy we adopted for this pest was to pick off the infested shoots and burn them, which of course means a lot of labour; but what else were we to do?"

Dr. Chapman's observations of the young caterpillars which come out from the fruit, hiding themselves amongst the dead scales to be found at the bases of buds and fruit spurs, and there spinning a white firm cocoon in which to pass the winter, opens out another method of prevention. We could not very well do anything towards clearing out individually cocoons spun for the accommodation of a caterpillar only about one-twelfth of an inch long ("the young larva on retiring for hybernation is only 2 mm. in length."—T. A. C.); but looking over the bushes, and if little white spots were seen, clearing out the old

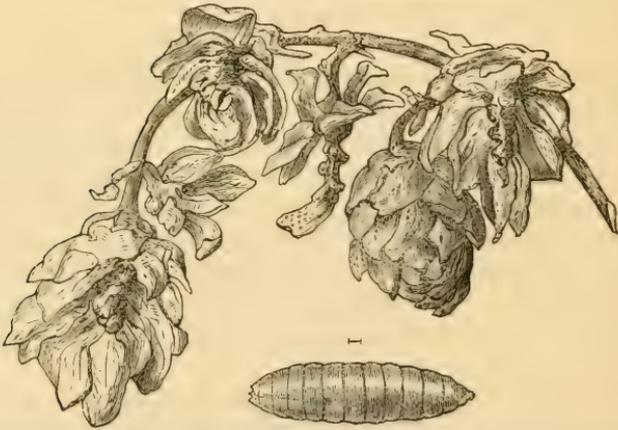
* See "*Lampronia capitella*," by Dr. T. A. Chapman, 'Ent. Monthly Mag.,' No. 36, December, 1892. Price 6d. Gurney and Jackson, 1, Paternoster Row, London.

rubbish in which the cocoons are sheltered, would be to some degree practicable. Or an application of strong soap and sulphur would do good.

Whether anything could be done with regard to shaking off the infested and prematurely ripening Currants does not yet appear. In some other kinds of attacks in which, as in this instance, the infesting maggot destroys the seed, the fruit consequently drops, and if this should be the case also with our *Incurvaria* attack, we might get rid of much of the pest by shaking the bushes, so that the fruit should drop on to cloths, and, destroying this before the maggots had time to escape, and re-establish themselves on the Currant bushes to form winter quarters.

H O P.

“Strig Maggot.” *Cecidomyia* ? sp.



Hop catkins, showing effect of infestation; “Strig Maggot,” magnified, nat. length given by line.

The Hop Strig was again troublesome in various places, and its presence was reported in Kent, from the neighbourhood of Canterbury, Maidstone, and Gravesend, and in Worcestershire, from near Tenbury.

The mischief is caused by the little white maggot tunnelling in the central stem of the Hop-cone, so that this is destroyed for all useful purposes. It may only wither and turn brown, or the damage may be so great that the attacked part, and the little side stalks by which the separate flowers forming the “cone” are attached, may decay, and on

splitting up the decayed mass the maggot tunnels and cells will be easily seen.

The various observations of attack were sent in September; the first (on the 5th of September) was sent from Upper Ensinge, Crilham, near Canterbury, by Mr. Edw. Leney, who mentioned:—“I have forwarded a quantity of small maggots which are found embedded in the core of the Hop, and doing considerable damage; in fact, in a very few days the Hops go quite brown, and become useless. I shall be much obliged if you will let me know the cause of same, and if anything another year can be done to prevent it; I think perhaps getting an abundance of sap in the bine, to an extent increases it.”

A little later (on the 10th of September), Mr. Edward Goodwin, writing from Canon Court, Watringbury, near Maidstone, sent the following observations, which will be seen to be of considerable interest. Mr. Goodwin notices the great number of “cones,” which, on careful examination, he found were infested; also the great number of maggots (up to 40 or 50) which were to be found in a single head; and the fact of the maggots, at the time of observation, leaving the cones to bury themselves in the ground, which is very important relatively to preventive measures, is also noticed.

Mr. Goodwin, alluding to a previous letter on the “Strig maggot,” remarked:—“Since writing you, I have looked more closely for the above, and regret to find that the attack is more general and severe than I thought.

“In two gardens I went into yesterday, I failed to find a single cone not attacked, and some contained 40 or 50 maggots. They are leaving the cones rapidly, and I found large numbers on the ground about to bury and pupate. I have been keeping some branches of Hops in my larval cages, and I find that the maggots bury themselves in the earth within a very few minutes after they fall. I notice that they can spring an inch or two, apparently by a sudden contraction of the body.

“I intend to try one or more of the methods for killing the pupæ you suggested last year in the letter you wrote me then.” . . . “I believe that the damage done by this insect is enormous this year, although not so apparent as sometimes on account of the comparatively cool weather which has kept the Hops green, even where strigs were eaten out. Two or three hot days’ sun would show the mischief.”

On the 19th Sept., Mr. Hartridge, writing from Ifield Place, Thong, Gravesend, requested information as to what would be the best remedy for destroying the maggots that were in the strigs of the Hops sent accompanying, without injury to the plant, at what time of the year to use it, and when was it likely the attack was commenced?

Another application was also sent me by Mr. Wallace, from Ear-

diston, Tenbury, Worcestershire, requesting information as to any practicable way of extirpating this infestation "which during the last two seasons had increased very rapidly."

The only methods of prevention of this attack would appear to be (as previously suggested) destroying the pest in the ground. We know that the maggots fall down from the Hop-cones, and they have been seen to bury themselves, and we know nothing more about the infestation until we find the Hop-cones being ruined by the Strig Maggot in the following year. It is quite plain that this attack must necessarily originate from the Strig Maggots, having in due course developed to the little Gnat-Midges, minute Gnat-like flies, scientifically, *Cecidomyia* very much in appearance like the well-known Wheat "Gnat-Midge," which produces the "Red Maggot" of the Wheat; and the only available treatment appears to be so treating the Hop hills as to get rid of the pests lying at the surface before they develop to flying state.

How best to do this is a matter for consideration of the Hop growers. No one else can be *certain* to give right advice, consequent on not knowing with certainty when, or how, in course of regular cultivation, the requisite treatment can be given.

Any disturbance of the surface of the Hop hills which will throw just the surface open to weather, or distribute just the uppermost film with its maggot contents on the land round, would certainly do good. Thus the minute maggots would be exposed to the alternate wet and cold of winter, which is a known means of maggot destruction, although maggots will stand severe cold in their own shelters.

P.S.—Whilst the above observations were going through press, I gathered, from an incidental remark in a communication from Miss Frances Pye, of Knights Place, Rochester, that some form of treatment had been found to be of service in clearing Strig Maggot attack, and on inquiry she wrote me as follows:—

"My father thinks he got great good from letting the sheep be on the ground where we were most troubled with Strig Maggot. He had Wurtzel, Turnips, and Swedes carried out to them, and let them tread the ground well."

I have let the previous observations stand, as (if practicable) exposing the grubs to weather influences would be likely to be of use. But where sheep could be put on the land, so as to press the ground firm over the grubs, and also poison the surface (to the grubs) with their fluid as well as solid droppings, the effect might be expected to be very serviceable.

MANGOLD.

The Pigmy Mangold Beetle.* *Atomaria linearis*, Stephens.



ATOMARIA LINEARIS.

Beetle, much magnified, after Taschenberg. Nat. length one twenty-fourth of an inch.

For some years back enquiries have been sent me from time to time, regarding the nature of an attack which was very injurious to young Mangolds. The serious nature of the mischief was obvious, from the condition of the plants received, and so far as appeared from examination or description, sent accompanying, the damage was caused by the roots being gnawed, or in some cases, the top of the plant being eaten into at the ground level, the plants being thus destroyed. But still, although I examined the specimens sent me most carefully, I was not able to discover the cause of the mischief.

Now, however, we have gained a clue from receipt of identification of a bad attack to young Mangolds at the Royal Agricultural College, Cirencester, being caused by infestation of a kind of exceedingly minute beetles, known scientifically as *Atomaria*, and this attack was noted as agreeing exactly with that of the *Atomaria linearis*, well known on the Continent for its ravages to Beet or Mangolds. From this, and from the specimens of injured plants sent me (though without the cause of evil accompanying), agreeing so nearly with different forms of this infestation, it seems to me to be scarcely open to doubt that the attacks to the young plants in all the instances reported were of this *Atomaria linearis*.

This is an exceedingly small beetle, only about half a line, that is (one twenty-fourth of an inch), in length, narrow and long in shape, and somewhat flattened or depressed; slightly downy; in colour varying from rusty red to black. Horns slender, terminated by a

* As this beetle does not appear to have as yet any English name, the above appellation referring to its exceedingly minute size, and its crop food-plant, seems to distinguish it fairly. In German it is described as the "Runkel-ruben Kaferchen," or "The Beet (or Mangold) little beetle." But as this form is cumbrous, and also at one time *Pygmæa* was one of its scientific names, the prefix of "Pigmy" appears to be allowable and appropriate.

three-jointed club, and chestnut coloured, as are also the six short legs; wings ample.

This beetle is well known on the Continent as seriously injurious to Beet or Mangolds, but I am not aware that it has been brought forward as similarly hurtful here, although John Curtis in a short notice* of this *A. linearis*, mentions that "it is abundant in England, and no doubt affects the crops of Mangel-Wurzel in this country."

The first Continental notice of it appears to have been by Mons. Bazin, who observed this insect in 1839 at Mesnil, St. Firmin, but I believe that the observations by Prof. Allen Harker in 1891 of an *Atomaria*, as being seriously injurious to the Mangold crops at the Royal Agricultural College, Cirencester, are the first record of an insect of this genus as a regular Mangold pest in England.

On the 27th of February in the present year, Prof. Harker wrote 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 some extracts from the publication mentioned below, of which he remarked:—"This most accurately describes the appearance of our Mangolds, and I could have collected hundreds of the *Atomarias* at each plant"; and he also remarked that he had not thought previously that they were such serious pests.

The extract is as follows:—"Injurious insects: Beet is attacked during its growth by the larva of the 'Cockchafer,' called the 'White grub,' and by a very small insect of the order *Coleoptera*, observed for the first time in 1839, by Armand Bazin. This insect, to which the name of *Atomaria linearis* has been given, belongs to the family of the *Clavicornes*; it is narrow, and hardly a millimetre and a half long; its colour variable, from rusty red to black-brown. This little insect appears in May and June. Then it attacks the young Beets, gnaws their tap-root (*le pivot de leur racines*), and eats their leaves. It is during dry weather that the ravages are the most severe." †

In most instances the plants sent me were, as far as I saw, dying from injury to the root, but in the following note which accompanied samples of injured plants sent me on the 26th of June, from Haughton Hall, Shifnal, Shropshire, by Mr. J. T. Brooke, it will be seen that another of the forms of mischief caused by the *A. linearis* is described.

Mr. Brooke observed:—"My Mangold crop is being decimated by some pest which nibbles round the neck of the plant just at the ground level. Hitherto I have been unable to detect any creature at, or near, them." The soil was described as "light and dry," and

* See 'Farm Insects,' pp. 395, 396.

† From 'Cours d'Agriculture Pratique: Les Plantes Fourragères,' par Gustave Henze. Paris: Hachette, 1861. Betterave, pp. 33, 34.

(after some observations as to methods of counteracting the ordinary Mangold-leaf Maggot attack) Mr. Brooke added, "This new enemy, however, leaves no hope, as each plant attacked is killed outright."

On the 8th of June, specimens of two kinds of attack to young Mangolds were sent me by Mr. W. A. Bewes, of the Tile House Denham, Bucks, with the observation:—"All the fields about here are afflicted with what looks like a double scourge. The leaf has a maggot, which is preceded by a tiny white spot, which I suppose is an egg; and the root withers from the bottom, looking as if the bark were eaten off."

The plants injured by the maggot in the leaf were obviously suffering from attack of larvæ of *Anthomyia betæ*, what may be called the regular Mangold maggot attack; but there was nothing to show what might be the cause of the root injury. It was clearly a separate form of attack, but no insects were to be found attached. A further supply of young Mangolds, all attacked at the root, was sent me at my request, but still no insect cause accompanied. Mr. Bewes noted:—"The disease was discovered by Mr. Wm. Davis, who is a tenant of Mosses Farm, Chalfont St. Peter, and I have gathered these specimens from him. He observes that the disease is the worst on the hottest land, such as gravel."—(W. A. B.)

Nothing further occurred until towards the end of the year, when, on my request for any further information which might have come to hand, Mr. Bewes was good enough to procure me the following observation from Mr. Richard Davis, son of Mr. W. Davis, of Mosses Farm, which (excepting that the astonishing amount of these minute insects was conjectured to be a visitation of ants) agrees well with description of *Atomaria* attack. Mr. R. Davis reported as follows:—"With reference to the Mangold roots you inquired about, the damage was done to the roots about an inch in the ground, the rind being taken off, and, in most cases, the plants so eaten withered away."

Here it was remarked that the damage was conjectured to have been caused by young ants when in winged state; but, as is needless to observe, without special knowledge of the habits of insects, and also without a strong magnifying-glass, it is next to impossible for a flight of insects only about a twenty-fourth part of an inch in length to be accurately identified, more especially as the "Pigmy" beetles are very much ant-like in colour,—"rusty-red to black."

Mr. Davis noted that "the light gravelly or sandy part of the field seemed to be smothered with these 'insects'; it was on this sort of soil that the greater part of the damage was done to the roots. There were a lot of holes bored round the roots of those plants that did not die, and later on the leaves seemed to be eaten so that they turned black, and withered away. After this more young leaves came, but

always small, a complete mass of them all over the crown of the Mangold, and (at the time of lifting) the top was short and bushy, and the bulb very small. On the loamy part of the field little damage was done, and the Mangolds were four times as large.

“The land was a Wheat stubble, ploughed in the autumn, the manuring and other cultivations being done in the spring. There was no second sowing. The sort was Golden Tankard.”—(R. D.)

The above clear description agrees well with the main points laid down by technical observers of *Atomaria* attack. We have the bad gnawing at the roots of the young plants, also the lesser injury of holes being bitten into them, and also the damage to the leaves.

The enormous amount of the creatures to be found in the ground, which is a point especially drawn attention to in M. Bazin's account, is also noted in the following further notes with which I was favoured from Mr. James Girdwood, Estate Agent, after further inquiry:—

“Early in October I observed large patches on which the roots were evidently dying off, and none of us could account for it, but believe the cause has been revealed by Miss Ormerod's letter, as I saw Davis the other day, who informed me that he had observed the cause in taking up the crop, when they found at the roots ‘hundreds of millions of ants which had gnawed the fibres of the roots’”; and now Mr. Girdwood notes that he believes, from the information in my letter, that these supposed ants were really the *Atomaria* beetles. The result of the attack was “something like half a crop of seedy-looking roots.”—(J. G.)

At present the only case in which we have secured identification of the *Atomaria* beetle in connection with its attack, is that furnished by Prof. Harker, of Cirencester; but to show the similarity of our attacks with the authorized descriptions, I append notes on these points; and first as to the serious amount of destruction to the young crop, the injury at the ground level, and also to the roots, thus well-described in the account of this infestation given with great minuteness by Dr. J. Ritzema Bos, Professor at the Royal Agricultural College, Wageningen, Netherlands:—

“It is often observable in the spring that the young plants of Sugar Beet are very irregularly distributed on the land. On many parts of the field absolutely none of the young plants are to be found; on other parts a couple of seed patches may be found still bearing young Beet plants, but these already withering, and of a yellow colour, it is impossible to take them from the ground without tearing them to pieces. The lower part of the stalks are badly eaten below the surface of the ground, and the damage extends even to the middle of the underground parts of the stem. The root is often similarly gnawed in places, and the wounded parts become black. If one of

these little Beet plants has the earth partly removed, and the roots laid bare; then these minute beetles may be observed at their destructive work. They perpetrate their devastation still underground; often the stalks of the young plants, before these have as yet reached the surface, are destroyed beneath the seed-beds, so that the plants come to nothing."*

Later on it appears that if the weather is favourable these minute beetles come above ground, and extend their attacks to the leaves, sometimes causing total destruction; but in case this attack has not taken place until the plants are fairly advanced in growth they may get over it.

The description quoted by John Curtis (see 'Farm Insects,' p. 395) gives in short compass a good description of the infestation:—"We learn from M. Bazin that this minute beetle is generated in great numbers, destroying the buds as they appear, and, on removing the clods of earth, one often sees enormous quantities. It does not content itself at a later period by attacking the root, but when it is fine weather it comes out of the ground, ascends the stem, and devours the leaves. These little creatures often appear in families on a plant of which in a few hours nothing remains but a leafless stalk, which presently withers and dies."—(J. C.)

On warm evenings the beetles come out of the earth, and rising in the air they pair. (See 'Praktische Insekten-Kunde,' by Dr. E. L. Taschenberg.)

The maggots are believed to feed at the roots like the beetles, but excepting that they originate the coming more severe and general attack they are not recorded as doing much harm.

The above descriptions of injuries agree so well with what had happened to the samples that, joined to Prof. Harker's observations of the beetles in connection with their destructive work, it appears to me that we have now found the cause of the severe injury to the young Mangolds which has been reported of late years. The excessive minuteness of the beetles, and likewise their subterranean habits, have doubtless been the reason for their escaping field observation, and consequently none of them reaching me, together with the plants when drawn from the ground. But the above observations will be enough for identification of the attack should it again occur, and if in this case I could have some specimens of the little beetles forwarded in a piece of quill, together with the samples of the injured young Mangold, we should be able to trace out the matter fully, and guard against recurrence.

* 'Die Tierische schadlinge, und Nutzlinge, &c., Praktische hand-buch' (p. 259), von Dr. J. Ritzema Bos. Berlin, 1891.

PREVENTION AND REMEDIES.—Liberal sowing, so that a portion of the plants may escape anything but excessively severe infestation, and thus enough to give a crop may survive, is one of the measures recommended.

Liberal manuring is another. By this means the attacked plants may be helped over the time of the duration of infestation, in case the number of the "Pigmy Beetles" is not overwhelming, and such of the plants as may be slightly, or not at all attacked are pushed on to a hearty growth. But looking at the circumstance of *Atomaria* beetles being recorded as occurring in vegetable refuse, and "often harbouring in dry dung"; this may throw light on the way in which, in some instances, the "Pigmies" (to give them a more convenient name) have come on the land, and also suggests that chemical manure might be a serviceable application. We know how well nitrate of soda often assists Mangolds through leaf maggot attack, and in case of the root attack now under consideration, the fact of the solution running down close to the little plants, and thus presenting the maggots with the choice of starvation, or chemically impregnated food, and the little beetles with what presumably would be distasteful to them, could hardly fail to be helpful to us.

Rolling is said to be a good remedy, but looking at the beetles being for the most part under-ground workers, and also at their exceedingly minute size (hardly as long as the ordinary letters in these lines *without* the tops), it would appear difficult to do anything in this way towards keeping them from feeding or moving about, which would not at the same time injure the plants.

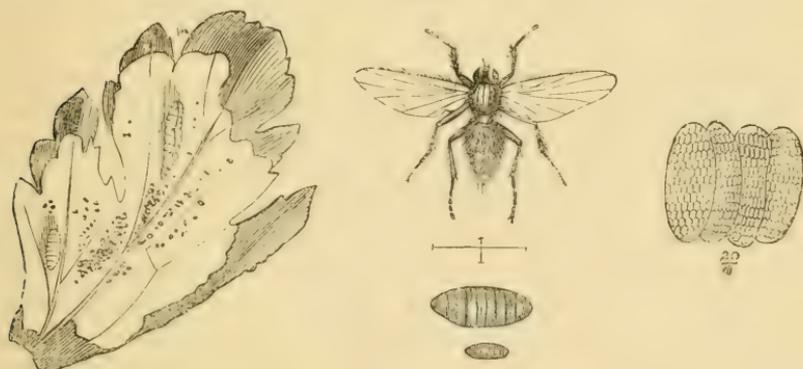
Where Sugar-Beet is very largely grown, as at various localities on the Continent, these small beetles are apt to be most seriously injurious, and rotation of crop such as will clear the infestation out of the land, is the best remedial measure. This, however, is not always easy to carry out. Sugar-Beet growing is a great industry, and all the land available is needed by the growers. On this account the plan has been recommended of *planting instead of sowing* the Beet where attack is prevalent.

The Beet seed is sown on a piece of ground which (compared to the Beet fields) is of small size, so that the locality of this can be changed year by year, and seed ground thus secured clean of infestation, on which the plants can be started. "Then the Beet is planted out in the fields, where Beet was grown even in the previous year. In this way the plants are not exposed to the danger till they are in a condition to resist it."—(J. R. B.) In this country the attack is not the scourge that it is on the Continent, for the reason that Beet growing is not a special industry, but (as it is characteristic of the workings of these little beetles that they attack the germinating

plants even before they are well through the ground) the above principle might be usefully applied with us in "patching."

In the coming season it would be very desirable to have more observations, to enable us to identify what attack, or attacks, are prevalent at young Mangold roots. We know that Atomaria attack was found at Cirencester, and attack resembling it elsewhere, but other infestations may be present. If observers would kindly send specimens to myself, I would do my best to investigate thoroughly.

Mangold "Leaf-blister" Maggot. *Anthomyia (Chortophila) betæ*,
Curtis.



ANTHOMYIA BETÆ.

Mangold Fly, and eggs (after Farsky), magnified, with lines showing nat. length, and expanse of wing; chrysalis nat. size and magnified. (For explanation of blistered leaf, see p. 84).

The attack of the Mangold-leaf Maggot was again prevalent to a serious extent in various districts, ranging, for the most part, across the more southerly and midland parts of England.

The most northerly localities reported from were in Yorkshire and Lincolnshire; some injury was reported from Glamorganshire, in S. Wales, but otherwise the attacks noted were mostly at places, or affecting districts, in Cornwall, Devon, and Hants; more inland, in Warwickshire, Berks, Bucks, Herts, and Surrey; in Bedfordshire and in Essex, there was also presence of the infestation, and enquiry regarding it was also sent from Norfolk. It may be presumed that the infestation was present at many other localities besides those from which enquiries were sent, but still these give some idea of its prevalence.

The date of the first series of enquiries ranged from May 31st to June 20th. From the specimens sent, and observations accompanying, the attack appears to have begun in some cases as soon as the young

Mangold leaves were large enough to accommodate a fair sized blister, and during the period named, enquiries were sent on most days, and sometimes several in the course of one day. From the 20th of June onwards, there was little if any further enquiry about this infestation until nearly the end of July, and again towards the end of August, when some amount of further communication occurred regarding its appearance in the large leafage of the plants, then well advanced in growth.

Looking at the amount of attack running so far west as Devon, and the neighbourhood of Truro, in Cornwall, it is of some interest to notice its absence in Tresco, Isles of Scilly. Early in August, Mr. Winfield, writing on the part of Mr. Smith, consulted me as to another kind of injury then occurring to Mangolds, and I took the opportunity to make special inquiry as to presence of the Leaf Maggot, the larva of the *Anthomyia betæ*.

On the 3rd of September, Mr. Winfield replied that he had noticed the accounts in the papers, and was on the look-out for it, but he was glad to say that it had not made its appearance there.

Although this Mangold-leaf Maggot occurs more or less every year, and sometimes very badly, it is still so often not recognised, that I have now added (page 83) a figure which shows the method of injury to the leaf. Not being able at present to give a figure of the Mangold leaf itself in its infested state, I have substituted one of a Celery leaf, which, though injured by another kind of fly-maggot, yet gives an excellent idea of the way in which the Mangold leaves are blistered, so that the upper and under skin are separated in patches, and the films to which they are reduced at times become so transparent that the shape of the maggots feeding within can be seen. For the most part, however, the patches merely show as white blisters a little raised in places where the maggots are lying within, or (further on in the attack) these destroyed parts turn brown or discoloured, as if bitten by frost, to which not unfrequently the injury (till investigated), is attributed.

The maggots of the Mangold Fly (which at life size are almost or wholly indistinguishable from that figured in the leaf) are whitish or greenish, fleshy, cylindrical, legless, truncate or blunt at the tail, and pointed towards the head end, which contains two black hooks within it, wherewith the maggot scrapes away the soft substance between the two sides of the leaf on which it feeds. According to its age it may be smaller, or a little larger than the larva of the Parsnip and Celery Leaf-miner Fly figured.

The maggot usually quits the leaf-blister when full-fed, and turns to a chestnut-brown chrysalis in the ground. Sometimes, however, the change takes place in the leaf-blisters. It is of the shape figured,

magnified, with the life size given beneath it, and also life size in the leaf.

In summer the small two-winged ashy-grey Mangold Flies (figured, magnified, at p. 83, showing the darker markings, and black bristly hairs) come out in about a fortnight, so that there may be a succession of broods throughout all the warm weather. The white, oval, or somewhat spindle-shaped eggs of the fly are laid in patches beneath the leaves.

Though this attack has often been entered on before, some few of the notes sent in regarding it during the past season may be of interest in showing the serious nature of the attack, and how much a better knowledge of its characteristics is in some districts still needed, in order that remedial measures might at once be brought to bear.

On the 6th of June, Mr. J. H. Hine, writing from Pamphlett Farm, Plymstock, Devon, remarked:—"I am sending you a sample of my young Mangold plants with a maggot in them doing serious damage, destroying many plants altogether. Would you be kind enough to send me a remedy (if any) at once.

"I find from most farmers in this neighbourhood that they are suffering the same as myself."

On the following day (June 7th), Mr. R. Templeton, writing from Blackweir Home Farm, Cardiff, S. Wales, observed:—"I find that our Mangold is infested with the grub in the leaves, which is doing very great damage to them; I am afraid they are going to destroy the crops altogether. I have heard several farmers in this district complaining about their crops, and saying they were like as if they were frost-bitten; but I expect that if they look carefully, they will find that it is the grub that is doing all the mischief. I would feel very much obliged if you could give any information how to destroy the pest."

On June 8th, Mr. W. Campin, writing from Lanes Farm, Woolley, Reading, also noticed the attack, being at first mistaken for frost-bite. He mentioned:—"My Mangolds are eaten off by some grub. We at first thought it was the effects of frost; on closer examination I find a small grub inside the leaf, and have enclosed two leaves for your inspection. Can you kindly inform me the cause of this destructive pest?"

On the 9th of June, Mr. Thos. Olver, wrote to me from Truro, Cornwall, as follows:—"I happened to be on a farm near this place to-day, when the occupier told me that he had a disease of some kind among his Mangold plants, so I went with him into the field, and had no difficulty in finding a large number of plants affected similar to the enclosed." . . . "If you would kindly give me some information as to the cause and prevention, I should deem it a favour."

Still taking one of the reports received on successive days, the

following note of enquiry was sent me on the 10th of June, by Mr. W. J. Harris, of Halwill Manor, Beaworthy, N. Devon :—"The Mangolds here are coming up splendidly this season, but all the earliest plants have been attacked by the Beet Fly, and we are wondering how it will turn out. Some farmers fear that they will lose the crop. Can you throw any more light on the subject?"

On the 11th and 16th of June, specimens and communications sent by one of our leading firms of seed-growers, noted presence of this attack in Essex and Bedfordshire; and on the 18th of June the following remarks sent me by Mr. Geo. Drewitt, from Guildford, showed the very early age at which the Mangold plants were liable to be struck by the fly.

Mr. Drewitt observed :—"I enclose the leaves of some Mangold plants showing different stages of mischief caused by a maggot living between the skins of the leaves; apparently the eggs are laid when the plants are just putting out the second pair of leaves, and the evil shows when the plants have a leaf about the size of this rough sketch" (here a sketch was inserted of a young Mangold leaf, half an inch wide by about an inch and a quarter long.—ED.)

"Evidently the attack is not to be despised, for about 85 per cent. of the plants have two or three leaves infested, and although they will probably survive the present attack, I am anxious to know what will occur a little later on."

That the attack was not confined to the westerly or southerly districts, is shown by the two following notes. The first sent by Mr. W. Meesom, Doggetts, Rochford, Essex, on June 18th. In this, after alluding to some other specimens sent, he added further :—"I have also enclosed some leaves from young Mangold plants taken from a field I have at Battlesbridge, Essex. These you will find have a white maggot, sometimes two, in between the tissues of the leaves. There is a good plant of the Mangold, but from the leaves being so much injured they do not make any progress, and the weight of roots per acre will be much diminished.

"I have another field of Mangold which has lost plant, I think, entirely from the attack of these maggots at an earlier stage, as the leaves and plants withered quite away. Shall be glad to receive any remarks or suggestions you may be so good as to send me with respect to them."

The following east country observation was sent me on the 14th of June, from Hunton Hall, Norwich, by Mr. Chas. N. Douglas, in which, after noting the method of injury of the Mangold maggots sent, he remarked :—"This maggot is doing great havoc round about here. Can you give me any information about it, and how to stop its

ravages? If it were on the leaf instead of inside, we might have a better chance of getting rid of them."

Still the attack, so far as letters sent to myself indicated, was worst in the west, and amongst communications sent, one from Mr. Geo. Ross Divett, sent from Bovey Tracey, Devon, on the 16th of June, noted the infestation as having recently appeared in that neighbourhood, although it was not doing so much harm as in the parishes of Manaton and North Bovey, which lie high, and in which presumably the plants are small. "With us on lower ground the mischief is not so great. The maggot apparently eats its way out of the blister without reaching the more vital parts of the stronger plant, which is not seriously injured." On the 20th of June, another letter from the neighbourhood of Truro, mentioned the attack as being "very rife in this neighbourhood this season," and begged for information thereon.

The preceding notes are given just to show the serious amount of damage occurring from the maggot, also how early in the growth of the young plants (even when the leaves are only about an inch long) it is possible for the pest to strike them, and also how, from the withering and destruction of the leafage, the early attacks are at times attributed to effect of late frosts, and consequently no remedial measures adopted. I have also (though I usually remove anything of a personal nature from communications before publication) in these instances left the requests for information appended, as these show the general need (and also the desire) for more information regarding this attack.

Also as there is nothing objectionable in slightly altering a popular name in order to make it more clearly descriptive, I have added the word "blister" (see heading at p. 83) to the name "Leaf Maggot," as thus under the name of "Leaf-blister" Maggot attention will be drawn to the characteristic of the maggots being found not simply within the leaves, but within the blisters, or patches, which their destructive operations give rise to. These may easily be distinguished by the altered colour of the skin of the leaf. At first the patch is small and hardly altered in colour, gradually it increases in size, and the dead skin becomes whitish or variously discoloured, till in bad attacks the destroyed portions of the leaves, whether the blistered parts, or the parts destroyed by these injuries cutting off passage of the sap, become dead and brown.

The maggots do not by any means always show through the blister-skin to general inspection, but if the leaves are held up against the light they will probably be very easily observed, or the gentle application of a finger and thumb, so as to feel where the slight lump of the maggot presence may occur, will soon show their whereabouts

From the 20th of June no further communications were sent as to

outbreaks of attack of the "Leaf-blister" Maggot, until the 26th of July, when enquiries were sent me by Mr. A. G. Lucas regarding attack to a large acreage of Mangolds near Berkhamsted, within the last few days preceding, and which was stated to have "played sad havoc with them," as indeed appeared from the state of the specimens sent. The leaves were grown to a good size, but they were much injured by the maggots, which were then leaving them in numbers.

The latest date of attack of which information was sent, was Aug. 18th, when notes were forwarded me from Cadwell Highfield, Louth, Lincolnshire, by Mr. G. A. Browne, of "a most serious outbreak of the Mangold Fly and maggot," and requesting early information as to what could be done, as the crop looked as if it would be quite destroyed. In this case the Mangold maggot was present, but the mischief was increased by an accompanying visitation of Mangold Aphis, sometimes known as Dolphin, Black Fly, or Plant Louse, which I found in great numbers on the leaves sent me.

PREVENTION AND REMEDIES.—As in previous years, such small amount of remedial treatment as was reported turned for its success on pushing on the growth of attacked plants, so as to replace the destroyed leafage as soon as possible. For this nitrate of soda appears to act better than anything else, and in one case of early attack (in the middle of June) the application of two dressings of nitrate of soda and salt had a good effect. The plants were reported to be growing so well that it did not appear to be necessary to put in more seed.

The natural remedy of the rain was also reported as being very beneficial. From Romsey, Hants, on the 20th of June, it was noted:—"Since the rain the Mangold plants first attacked by the maggot are recovering nicely, and in our case I don't think the injury done will be so very serious after all."

From Louth, Lincolnshire, also it was noted after the attack reported on the 18th of Aug., that there had been very nice rain, and the writer's plants which had been dressed carefully with nitrate of soda, and also had lime applied, were starting into vigorous growth. In this case, as mentioned above, the attack was two-fold, both of the blister maggot and of Mangold Plant Lice, and the lime was not used as a stimulant, but to get rid of the Plant Lice.

No new information has been sent in this season as to remedial measures, only confirmation of the use of all treatment, whether of previous good cultivation and manuring; special dressings when the attack is prevalent, in case there is sufficient rain to dissolve the applications, and also the great serviceableness of rainy weather in checking the infestation. Though we cannot command this remedy,

yet the knowledge that it lessens the absolute amount of Mangold Fly infestation, and very greatly helps the plants to bear up under it, might sometimes save unnecessary ploughing up of a crop just on the verge of recovery.

The points of treatment have already been so frequently noted in detail, that I only add the following extract from my own leaflet on this attack giving the principles of prevention and remedy.

The only direct measures of remedy which appear to have been noted are,—1stly, the use of such fertilisers to the attacked crops as may push on vigorous growth, and so carry the plant through the time of injury; and 2ndly, endeavouring to get rid of the maggots by pinching them in the blisters; nipping out the infested bit of leaf; or by drawing the infested plants when the maggot attack comes so early that the crop will bear thinning. This last plan answers if the workers are well overlooked to make sure of the infested plants being drawn *and destroyed*, before the maggots can get away from the leaves to go through their changes in the ground.

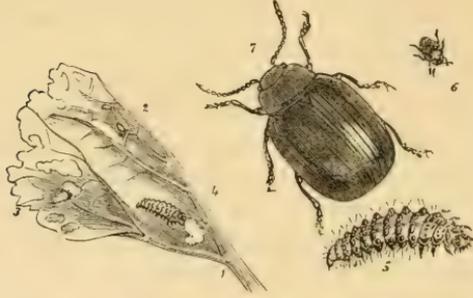
Any fertilising application will do good, which will act at once in furnishing nourishment to the plant, and thus keep it continually replacing by new growth the leafage which is destroyed by the maggots; nitrate of soda appears to do best, but, as the action of all these fertilisers depends on having rain at the time to wash them down to the roots, it is better to have previous good treatment of the land to trust to.

For this (where it can be done) autumn cultivation has been found to answer, and "the use of a mixture of farm manure, applied in the autumn as soon after harvest as possible, and a fair dressing of superphosphate, &c., put on with the seed," has been found to do well.

Dustings of various kinds have been tried, but, as these do not reach the under side of the leaves where the eggs are laid, nor the inside where the maggots feed, it seems likely that they only act by fertilising the land, or (as with paraffin in ashes) by causing a smell different to that which attracts attack.—(See 'Leaflet on Mangold Maggot,' pp. 2 and 3, by ED. Printed for gratuitous distribution).

NOTE.—As it may be of some interest to refer to what must be amongst the first regular agricultural notices of Mangolds as a newly introduced crop in this country, and the attention this excited, I add a few extracts on the subject in the Appendix, taken from numbers of the 'Farmer's Journal and Agricultural Advertiser' for May 8th, 1815, and April 8th, 1816.—ED.

MUSTARD.

Mustard Beetle. *Phædon betulæ*, Linn.

PHÆDON BETULÆ.

Mustard Beetle, nat. size and magnified; maggot, magnified, and nat. size on leaf.

Mustard Beetle attack is one of the regular yearly crop troubles. The first time in which it was brought forward for thorough investigation was, I believe, when (in the year 1886) circulars were issued by the Council of the Royal Agricultural Society to Mustard growers, requesting information as to the history and habits of the beetle (scientifically known as the *Phædon betulæ*, more popularly as Black Jack), and also what measures for prevention of attack, and for remedy of it when present, were reasonably practicable at a paying rate.

As Consulting Entomologist of the R. A. S. E., the work was placed in my hands; I went down into Cambridgeshire, to the neighbourhood of Wisbech, and with the able assistance of the late Prof. Herbert Little, of Coldham Hall, and that of Mr. Wm. Little, of Stags Holt, March, had the opportunity of examining the Mustard crops in the fields, and also I undertook the necessary correspondence with the contributors of information, and the subsequent arrangement of the main points of this information, for a special report published in the Journal of the Royal Agricultural Society in 1887.

The contributions of information were given (as far as could be) at length in my own Annual Report on Injurious Insects for 1886, pp. 58—76, with names of contributors appended to their observations.

The investigations showed that all or almost all available means of lessening amount of injury from this infestation were based either on the careful measures of preparation, or treatment of land, or (generally) of cultivation; or in some degree on prevention by forestalling attack. But of available remedial measures at that date, there appeared to be next to none. Such dustings, or washings, as were then tried did little or no good, and there were then no implements reasonably serviceable for distributing them. Now these points have been altered.

Many kinds of dressings, or washes, have been brought forward, some of which we know are beneficial in getting rid of similar attack in similar circumstances, and also much greater variety of implements for distribution of the sprays, or washes, are now available.

Under these circumstances much increased attention has been given to possibility of checking attack, whether of the grubs or beetles when present, and it is proposed in various localities to experiment, both as to effects of applications which there is reason to suppose may be of use, and also with regard to possibility of giving access amongst the crop to the requisite implements, or to bearers of implements for their distribution.

Much inquiry has been sent to myself as to what could be done for destruction of the infestation, and (as desired) I have endeavoured in the following pages to give the main points up to date of what is known as to the history of the insects, and available methods of prevention (to some degree), if not of *remedy* of its ravages. Also the measures which, from result of parallel experiment, that is, on the same nature of insects and of crops, appear likely to be of service.

There are several kinds of beetles which infest the Mustard crop, but the one especially known as "The Mustard Beetle," is of a deep full blue or greenish colour above (so shiny as to be almost of a glassy lustre), and black beneath. The legs and horns are also black. It is oblong oval in shape, about the sixth of an inch long, slightly punctured on the back, and has two wings.

The grubs, which are of the shape figured at p. 90, are about a quarter of an inch in length when full-grown, slightly hairy, of a smoky colour, spotted with black, with black head, and stout black conical horns, lighter at the base. They have three pairs of claw-feet, and a sucker-foot at the end of the tail, and along the sides of the body are a row of tubercles, from which the grubs have the power of protruding a yellow gland.*

The method of life is for the beetles to winter in any convenient shelter, in the most various kinds of localities. It may be in the ends of Mustard stocks, or in the roots of old Mustard plants left on the land, or in rough shelters made of Mustard straw. In ditch or hedge-banks, in the earth or in the rough grass, or at the bottom of hedge-rows. Also they are to be found in crannies of walls, gateposts, old

* A good description of these grubs will be found in Curtis' 'Farm Insects,' p. 72, with the observation that he considered it far from improbable that they were the larvæ of the *Phædon betulae*, but (as the point did not appear to have been further gone into) in the course of my own observations I reared some of the grubs up to beetle state, and found that these larvæ (precisely corresponding with Curtis' description) turned, as he surmised, in due season to the *Phædon betulae*, or Mustard Beetle.

wood or bark, and are especially noted as fond of sheltering amongst the reeds and rushes, by ditches and drains, in fact, in any available shelter.

And to places of winter shelter from which the beetles are brought into connection with the coming crop in the spring must be added, what amount of Mustard Beetles may be in the Mustard seed; a matter to which attention has been more directed within the last few years than was formerly considered necessary.

From these winter quarters the beetles come out in spring and spread to any food-plant near, especially those (like Mustard) of the cruciferous flowered kind, as the Water Cress, the Common Bitter Cress, Charlock, Turnip, Cabbage, &c., and though of a different order, the Brook Lime, is also one of their food-plants.

These various plants serve the beetles for a place for their egg-laying until the Mustard is ready, consequently to clear what may be called the nurseries of the year's attack, as well as to prevent, so far as may be reasonably possible winter shelters being left for the parent beetles, are respectively methods of lessening coming attack.

On these food-plants, wild or cultivated, the beetles which have lived through the winter lay their small eggs, and then they die. The grubs feed voraciously, until they are full-grown, when they go down into the ground to turn to chrysalids. From these the summer brood of beetles come out, it may be in about a fortnight, more or less, and these start new attack, and thus the infestation goes on. It may continue till quite late in the autumn, as noted in the following observation sent me on Oct. 5th, from Preston, Hull, by Mr. H. L. Leonard, with specimens of the *Phadon betulae* accompanying:—

“I stated in my letter that a very heavy rain had apparently destroyed the Mustard Beetle, as none could be found a fortnight after it. I am sorry to say they have reappeared on some of the farms in large numbers during the past ten days. I enclose specimens.”—(H. L. L.)

Where this appearance of successive generations of the insects thus alternating in grub and beetle state, is not well known, it is very important practically that it should be thoroughly understood. It is often thought that when the grubs disappear the danger is past, but this is not at all the case. The disappearance of the grubs is (in natural course) only the forerunner of their reappearance in beetle form to over-run the plants once more, or migrate in legions (if they do not find sufficient food) to other pasturage.

PREVENTION AND REMEDIES.—When the beetles are on the young plants, rolling has been tried, but even rolling with the “Crosskill,” so far as reported, has been of little use. Hoeing has been considered

(in some slight amount of notice) possibly to have done good when the grubs had lately gone down to turn to chrysalids. It was thought that turning these out, or throwing them open to the birds in this condition had helped to prevent as much of the next brood of beetles coming out, as would otherwise have been the case. Besides this, which is hardly worth notice, the sole remedy which was reported in 1886 (and even this has been exceedingly little noted in this country) is the expensive and troublesome method of collecting the beetles into bottles or mugs.

In 1886, Mr. W. M. Meesom, writing from Battlesbridge, Essex, reported:—"I have been on the look-out for the beetle for three weeks past, and on Wednesday last, two or three made their appearance. I have now two men doing nothing else but collecting the beetles, which we put into bottles, and scald every night. They collect on an average between 300 and 500 each per day, and, I believe, we shall be able to save the crop. My Mustard is now from 3 to 4 feet high."—(W. M. M.)

The great difficulty in carrying out this plan, or rather the broad-scale adaptations of it which suggest themselves, is the difficulty of workers moving through the Mustard without really doing more harm (by their crushing and breaking down the crop) than the infestation itself. If the crop was so sown that there was passage amongst it, the beetles might be shaken down in the morning or evening, or when weather influences made them torpid, into bags, or pails, or baskets, held below.

In the case of the small Raspberry Beetle, the *Byturus tomentosus*, so destructive and difficult to get rid of in Raspberry plantations, Mr. C. D. Wise, the Superintendent of the Fruit Grounds at Toddington, Gloucestershire, wrote me in June of last year (1891):—"We have been shaking the bushes over bags soaked in paraffin with excellent effect."

If in Mustard growing we could get at the plants, so that the beetles could be knocked down on anything held beneath, where they would be killed, and thus cleared in a sort of wholesale method of operation, this would get rid of so much, both of present and coming mischief, that the outlay would probably be well returned.

The only other method of destruction that I know of for the pest in beetle state, is by burning damp straw before the advancing hordes when, as is sometimes the case, they are migrating in great numbers from a ravaged field to fresh ground. By arranging a cart-load or two of damped straw across the line of march and firing it, the advance may sometimes be stopped, but not always, for they are known sometimes to escape mischief to themselves by going down into the earth.

At p. 95, a few lines will be found of a method of "trapping" the

beetles by placing Mustard straw round the field where harvesting is going on, and so being able to collect and destroy large numbers.

Amongst preventive measures, removal of all kinds of shelters is sure to be of use, and so far as getting rid of old Mustard rubbish, such as roots, old stocks, or old straw, or not allowing this to be used for rough sheltering of various kinds, this might be fairly easily done. And giving such attention to rough growths at the bottom of hedges, or the reeds and rushes by ditches, and other localities, as could be managed, would be of use. But examination of seed for what amount of beetles might be in it, would be a very simple measure.

In the replies to inquiries sent in 1886, it was mentioned that the beetles were frequently to be found in the Mustard seed when freshly threshed, and also that the beetles had been found alive in sacks of the seed for two years after it had been threshed.

In last autumn, notes were sent me of appearance of the beetle to a serious extent on two farms having followed purchase of seed from elsewhere, and the infestation was believed to have been thus imported. At any rate this may so easily occur that it is a point which it would be well to look to. Writing regarding this during December to Mr. H. L. Leonard, of Preston, Hull, he replied on the 14th:—"There would not be the slightest difficulty in screening the beetles out of the seed after threshing; by altering the riddle in the winnowing machine (through which all seed passes, or should pass, before delivery) it would be done. Should a stray beetle or two get back to the screened heap, they could easily be killed by a lad standing by."

In 1886, Mr. Ernest Smith, of Southminster, Maldon, Essex, noted:—"I should think careful sifting in a close sieve would prevent their being sown with the seed, or I should think that the ordinary solution of vitriol which is used for dressing seed Wheat would kill them." This operation might be expected to do all that was needed, if due attention was given to not using the chemical in amount that would hurt the seed, and also to taking care that the beetles did not escape.

In ordinary course (unless torpid) they might be expected to expand their wings and fly away as soon as they felt the effect of the chemical, therefore the seed would probably need to be secured so that this could not happen. But where there were only a few beetles in the seed, these might be hand-picked without any great trouble.

Transportation of the beetles with seed in sacks is a really important matter, and where they are known to be present, baking the emptied sacks to destroy any lurking infestation as well as all other requisite treatment, is highly desirable.

With regard to inquiry sent as to danger from eggs being mixed with the seed? This would not be likely to do harm. The natural place for

egg deposit is on the food-plant, where the grubs soon hatch and find their food ready, and it has been observed that even where the eggs are laid on the leafage in due course, that if the infested crop is ploughed up, the eggs perish on the withered plants. Consequently it would not be at all likely that, in case of unhatched eggs remaining in the seed and being sown, these would produce grubs which could make their way to the leafage of the Mustard plants presently coming up from the seed.

All measures of cultivation, such as treatment of the soil beforehand, date of sowing, and plentiful and rich manuring, suited to push on a growth which would not go down on moderate attack, were, as matter of course, found serviceable. Details of these in different districts were given.

Application of dressings to destroy the beetle were reported as, for the most part, very useless. These included trials of quick-lime, dry lime, soot, salt, and sulphur, and amongst fluid applications trials of "rock oil" (petroleum), "Jey's fluid," and "Condy's fluid." Carbolic acid at a strength that killed the Mustard plants, only killed about 10 per cent. of the beetles!

In a case where gas-lime was mixed with fine dry ashes to make it powdery, and scattered over the leafage early in the morning (so that it might adhere), it appeared that some amount of good was done, and passing on to notes or suggestions recently received, there appears to be hope that there might be benefit from dry dustings with lime as a main ingredient.

On Dec. 14th, Messrs. Gilbert & Son, writing from Billingham, Lincoln, in reply to some of my inquiries, mentioned that various kinds of applications had not proved of service, but added, "The only thing we think likely to be useful was a mixture of quick-lime and other ingredients, and this we intend carefully experimenting with next season."

On Dec. 21st, Mr. H. L. Leonard, writing from Preston, Hull, remarked:—"In a letter received this morning in reference to the Mustard Beetle, the writer states, 'So far as experiments have gone, there has been no marked success with the preventitives. The very strong liquid acids, or poisons, seemed to retard the growth of the plant, even if it did not end it. The most efficacious result was from several dressings of a mixture of quick-lime and sulphur, in the proportion of 2 bushels of quicklime, and 10 lbs. of sulphur per acre, well mixed together, and put on while the dew is on the plant.' The same correspondent also advises the farmers to place Mustard straw all round the field when cutting for the beetles to run into, which must then be burnt."

The above remarks as to damage done by strong acids, &c., confirm

previous observations, but the ingredients, and proportions, and method of use of the lime and sulphur mixture, joined to a previous note of gas-lime having been considered serviceable, suggest that the well known mixture of the late Mr. Fisher Hobbs, which he found (and which since his time has been found) so serviceable an application for getting rid of Turnip Flea Beetle, might be found of similar use here.

This consists of quick-lime one bushel, gas-lime, in caustic state, one bushel, soot ten pounds, sulphur six pounds, all mixed well together, pounded very fine, and distributed by hand, or machine, on the infested plants in the morning or evening when the dew is on, or when weather is damp, so that the powder may adhere.

The above amount is enough to dress an acre of quite young Turnips, and as Turnip Flea Beetle, as well as some other kinds of small beetles falling under somewhat the same class of remedies, are amongst Mustard infestation, the application might prove very well worth trying.

Amongst fluid applications to be distributed by sprayers, a mixture of soft-soap and sulphur has been tried in the past season on Kale grown for seed with little if any injury at all to the plants. See paper headed Cabbage, pp. 20—23, of this Report. The mixture in this case was used against Aphides, but it may not unlikely be useful, both as a deterrent of attack, and as very bad for the young grubs, as neither soft-soap nor sulphur are suitable for their food.*

The details regarding composition, application, &c., will be found as referred to above, with address of manufacturers of the compound, and also observations as to possibility of getting it made up with an addition of Paris-green, which would be well worth trying.

There are objections to the use of Paris-green in powder form, but in the excessively minute amount in which it not only acts sufficiently, but which also *must not be exceeded* without destruction to the plants, the Paris-green can be safely used in fluid form. This may be in suspension in water, or given in dilute mixture with soft-soap.

The proportions requisite would have to be tried. On leafage of orchard trees we have found a proportion of not more than about two to four ounces of the arsenite in forty gallons of water was what might be recommended. But where the powder is applied in water, it should always be remembered that it must be kept thoroughly mixed. It does not dissolve, it is held in suspension. Therefore (where it is allowed) it settles to the bottom of the spraying machine, and the fluid at the

* A mixture of which soft-soap is a main ingredient, and which, so far as I am aware, somewhat resembles the mineral oil emulsions so much used in the United States, is sold by Messrs. Morris & Little, of Doncaster, under the trade name of "Anti-pest." I know it to have been very serviceable against some attacks, and think it might very likely be worth trial.—ED.

top is weak and does no good, and that at the bottom is too strong and burns the leaves.

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

Unless (as ought to be the case) the sprayers have an automatic arrangement for the purpose of keeping the fluid in motion, the Paris-green should be kept well stirred; and even then in the case of (say) a barrel, this should be well washed out after it has been filled ten or twelve times.

The "Knapsack" sprayer* is a very convenient form, as it can be easily carried by a man amongst the crops (where there is room for a man to pass), and at the pleasure of the bearer he can direct the spray where needed. But even with this form it is desirable between each filling to well stir round at the bottom of the can, so as to disturb the sediment.

The spray should be thrown so finely as to reach all parts of the plants and both sides of the leaves, and coat the leaves as with a fine dew, but it should not be allowed to run down and drip. As soon as dripping begins spraying should cease.

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

* The English agents for this sprayer are Messrs. Charles Clark & Co., Windsor Chambers, Gt. Saint Helen's, London, E.C., price 35/-, or possibly somewhat less.

† Full directions, both as to method of application, and precautions in use of Paris-green, are given in a short pamphlet arranged by myself, which I shall be happy to forward gratuitously to any applicant. But although with the most moderate care it may be used with perfect safety, yet as it is poisonous some caution is requisite. I give appended the observations on this head from my pamphlet:—

"Paris-green" is an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing, and should never be applied to fruit or to vegetables that are used for food. But, as is shown above, the quantity to which, in order to be beneficial, it is requisite to limit application in spraying is excessively small, and our English experiences of the past season, as well as those on the Continent of America where Paris-green has been used regularly in farm and orchard prevention for many years, show that with proper care it may be used with perfect safety.

The cautions to be observed in the use of Paris-green are:—The bags should be

It saves a great deal of trouble in mixing, and also risk of careless workers breathing in the powder, to use it in the damped form, which can be procured as well as the dry powder from Messrs. Blundell, Spence & Co., of Hull, and 9, Upper Thames Street, London.

The Paris-green spraying should of course *never* be used on plants when in flower, or it would injure the blossom; but with regard to any probable injury to animals, though we certainly always most scrupulously advise none should have access where there is a chance of Paris-green having fallen, still it is to be observed that where this has occurred, we cannot find that, in the small quantity in which only it can be serviceably used to the plants, any evil consequences at all happen to animals pasturing, or feeding where drip might fall.

One observer fed his mares and foals beneath the Paris-greened trees with no ill effects; another allowed his fowls free run under trees repeatedly sprayed; and in a very specially watched experiment, reported to our Evesham Fruit Growers Committee (during our first trials of effects of Paris-green), regarding the condition of a rabbit kept so as to have full injury (if any was caused) by "green" falling from the sprayed trees, it appeared on enquiry that the animal continued in excellent health, and, as it was further remarked, brought up a large family with great success!

The circumstance of Paris-green having now been regularly used over an enormous area of country in North America, as the effectual means of keeping down the Potato scourge, commonly known as the Colorado Beetle, is a strong reason for hoping that we might find it very serviceable for use against Mustard Beetle. The two kinds are very nearly allied, and both feed on the plants in grub as well as beetle state, and are consequently both open to similar remedial measures.

labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful green colour of the powder.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it.

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders, or, what is better still, have it in form mentioned above as "Paris-green paste," that is, the powder just damped so that it cannot fly about. If swallowed in any quantity by being drawn in with the breath it would certainly be harmful. An instance is on record in which a man employed to weigh out and wrap 5 cwt. in 1 lb. papers lost his life therefrom. But with the most ordinary care the application may be mixed and used, as well as hellebore and other poisons often applied in orchard and other farming work, with perfect safety.

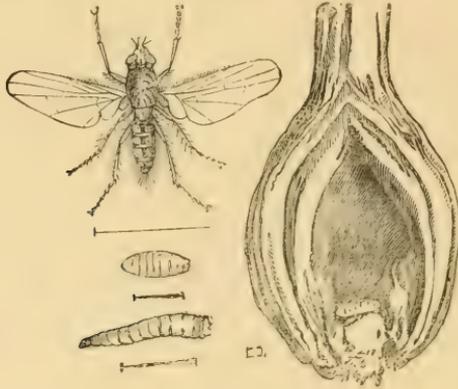
Some consideration is, I understand, to be given to trial with the Potato-spraying mixture known as Bouillie Bordelaise, but I should myself be afraid that it might so injure the outside of the Mustard leaves (by slightly hardening the skin) as to be prejudicial to growth.

The above notes are merely an endeavour to bring forward some of the points useful for consideration in dealing with Mustard Beetles, whether the *Phædon*, or other kinds which infest the plants; and in any of the details which I happen to have knowledge of myself, it would only be a pleasure to me to give any information in my power. Amongst these are observations kindly made for me by Dr. J. A. Voelcker, Consulting Chemist of our Royal Agricultural Society, regarding mixture of Paris-green with soft-soap; and also observations given me by Prof. F. Shutt, Chemist to the Dominion Experimental Farms of Canada, relatively to mixture of Paris-green with various kinds of soap, and also the extremely important observation relatively to *non-absorption* of Paris-green, that in a large quantity of sprayed Apples, subjected to analysis which would show the presence of even as small an amount as *one fifty-thousandth part of a grain of arsenic*, it was proved that they were free.

The main matter, however, in the preventive work appears to me to be *how to grow the Mustard crop* so that preventive measures may be brought to bear on it when it is past its first young condition. If we could but do this, I believe the clearance of the infestation would be easily practicable.

ONION.

Onion Fly. *Anthomyia ceparum*, Bouché = *Phorbia cepetorum*, Meade.
Shalot Fly. *Anthomyia platara*, Meigen.



ANTHOMYIA CEPARUM.

Onion Fly, maggot and pupa, magnified; lines showing nat. size; pupa in stored Onion.

On the 20th of June the following communication as to Onion maggot attack was sent me from Acle Villa, Cheltenham, by Mr. James Ricketts, with specimens of the infestation accompanying:—"The Onion crop in this neighbourhood is being devastated by a pest which appeared two or three years ago, and seems to be getting worse every year. One or more grubs enter and destroy the bulbs of the plants affected. The leaves droop, and the Onion shortly dies. In some places not more than one in a hundred of the plants survive, and so serious has the plague become, that many market gardeners have given up their culture.

"I have tried salt, lime, and soot as a top dressing, but without success; in fact I am inclined to think the application of the latter encourages the development of the grub." . . . "I am sending you herewith a few samples of the affected bulbs with the grub, *in situ*."—(J. R.)

(Soot is one of the applications which has been reported as sometimes of use in checking attack; still in my own experiments I found that where I had only a few minutes before dusted soot on the Onion bed, this did not appear to deter the Onion Fly from settling, even on the soot itself.—ED.)

On June 27th, the following letter was sent me by Mr. Wm. George (Hon. Sec. of the Greasley, Selston, and Eastwood Hort. Soc.), from Moorgreen, Nottingham:—"Several of the members of the Com-

mittee of our Society are suffering much loss in beds of young Onions. They first appear to be attacked by being blown in the points of the plant, from four to five eggs being observable, and soon a maggot begins to form, and grows to about half an inch in length; these soon attack the plant, and eat various holes in the bulb, which eventually destroy the plant." Enquiry accompanied as to the nature of the attack, and what could be done in the way of prevention of the ravage.

The above notes are merely given as observations showing the inconvenience and loss which still arise year by year, and in many places from want of information being made known generally, as to simple and practicable preventive treatment, and as the crop is one of great importance to all classes of growers it may be of some use to enter further on the subject.

There are various kinds of Onion Flies, of which the two species which we know best here are very like in appearance, but differ (or occasionally as circumstances require *may* differ) in their locality for egg-laying, which makes a difference as to method of prevention of attack.

The two kinds are the Onion Fly, the *Anthomyia ceparum* of Curtis (which is the same as the *Phorbia cepetorum*, of Meade), and another kind known as the Shallot Fly, which scientifically is the *Anthomyia platura* of Meigen.

As the attack of Onion maggot becomes constantly of more importance with the increase of farm-garden growing, and the infestation has been described now by many writers for many years, these descriptions being largely based on the original observations of John Curtis, I give the main points of these below (than which nothing can be better as far as they go), and which thus may be properly acknowledged to their original observer.

Writing of the *A. ceparum*, John Curtis remarks:—"Of this insect there are many generations during the summer, keeping up a constant succession of the maggots, which are yellowish white, with a pointed head and blunt tail (see figure at p. 100), and by eating into the bulb it decays, and the slimy matter that is secreted by these creatures causes the Onion to become eventually putrid and most offensive."

. . . "The eggs are stated to be deposited upon the leaves of the Onions, close to the surface of the earth, and as soon as the little maggots emerge from their shells they penetrate the outer leaf, and make their way between the leaves down to the base of the bulb, where they sometimes congregate in families, varying greatly in size and number."

(The above noted method of injury is the point in which the *A. ceparum* appears to me to differ from the *A. platura*, the so-called

Shallot Fly. Where I have had the opportunity of watching method of attack of which the flies (the *A. platura*) proved to be of this species, I have found the injury was begun for the most part at the base of the bulb, or at the lowest part of the side.—Ed.)

Continuing the observations of John Curtis with regard to time of duration of attack during the year, and also of duration of the condition of the insect in its successive stages, he remarks as follows:—"These maggots have been observed as early as May, and I have found them alive even in December, but June and July are the months in which they are in full force. In about fourteen days they attain their full size, when they generally leave the Onion, and descend into the earth, to become pupæ within their indurated skins, which form an elliptical chestnut-coloured shell; thus" . . . "they remain from ten to twenty days in the summer, before the fly is perfected and makes its appearance; but the autumnal pupæ rest through the winter in that torpid state, and the flies are not developed until the end of April or the beginning of May."

The male of the *A. ceparum* "is of an ash-colour, roughish, with black bristles and hairs; the eyes are contiguous and reddish; the face silvery white; horns black; there are three obscure lines down the back, and a line of long blackish spots down the centre of the body;" . . . "the wings are transparent, slightly iridescent, tinged with ochre at the base, the nervures pale brown; poisers ochreous; legs ashy brown.

"The female is ochreous or ashy grey, dotted with black bristles and hairs; the eyes are reddish, and remote with a light chestnut stripe between them, bifid and darkest at the base; face yellowish white."*

The flies of the *A. platura* are in general appearance very similar to the above, but there are minute differences, as some brown longitudinal stripes on the back, and some brown markings on the abdomen of the male; the legs black; the poisers whitish, with the stalk brown, and there are other slight points of variation requiring a good magnifier to make out. †

PREVENTION AND REMEDIES.—Attention is usually first directed to something amiss, and needing looking to, amongst the young Onions, by the leaves fading and turning yellow, and the bulb, or the base of the stem, even before the base can be said to be formed, decaying consequently on the ravage of the fly-maggots within. Under these

* See paper on the Onion and Cabbage Flies, by "Ruricola" (John Curtis), 'Gardeners' Chronicle,' 1841, p. 296 (by error for p. 396).

† For description see Schiner's 'Fliegen,' vol. i., p. 645, and 'Praktische Insekten Kunde,' of Dr. E. L. Taschenberg, Pt. iv., p. 130.

circumstances the best course is to raise all the injured Onions with the maggots within, and to destroy them at once. It is little or no use (or perhaps less than no use) *only* drawing the maggoty plants, for in this case a portion of the infested bulb is most likely to remain in the ground, and the maggots finding their food removed will stray through the soil to infest the nearest bulbs. The plants should therefore be carefully raised entire, and also not thrown aside, nor thrown to a rubbish heap, or the maggots will go on feeding as long as they need, or as long as the material lasts, and after turning to little brown chrysalids, they will develop in due course into Onion Flies, which will start new attack.

In looking over reports as to beneficial remedial applications, it appears as if all the usual insecticide washes, or dry dressings, might be of service; but amongst these, various washes of soap, or of which soft-soap forms a part, appear most likely to be of use.

Looking also at the different forms (whether in wash, or mixed with sand as a sprinkling amongst the Onions to be washed in afterwards) in which paraffin oil has been found serviceable, it is probable that a watering of soft-soap with a little paraffin *mixed* in it would be as good a remedial wash as could be found.

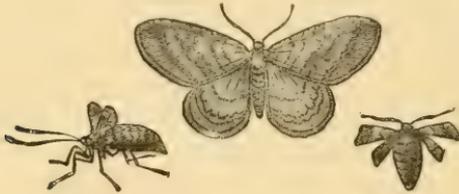
The difficulty in use of this, is from there being much trouble, to those who are not accustomed to the work, in making the ingredients unite permanently, and unless this is done a portion of the soft-soap is applied unscented by paraffin, and a portion of the paraffin oil being undiluted may very likely destroy the plants to which it is applied. Therefore the mixture sold by Messrs. Morris, Little & Son, of Doncaster, under the trade name of "Anti-pest," would in many cases save both time and expense from failures. It has been reported on trustworthy authority as having been found serviceable against various attacks, and I believe would do well with this infestation. Of course experiment would be needed as to strength admissible, both with regard to the age of the infested plants, how deep down they were in the ground, and all other practical considerations.

One thoroughly excellent method of prevention of attack is earthing up the bulbs so that the fly cannot get at them. In my own garden, I have found that sowing the Onions in trenches answered very well. All who have noticed Onions when growing, will have observed how often the bulbs, as they grow, become exposed on the surface of the soil, and open to fly attack. Where the plan is followed of the Onions being in shallow trenches, the earth can be sent down *on them*, instead of *loosened away* from them, by the successive hoeings, and the bulb is thus thoroughly protected. The effect on the growth of the bulb itself was also very good. The bulbs were both good sized and well formed. Liquid drainings from pigsties have been found very useful applications, and also house-slops.

Where amount of ground is limited it is very desirable to trench wherever Onion beds have been much infested, in order to put the chrysalids of the autumn brood down to a depth from which the flies cannot come up in the following spring to infest the new crop.

ORCHARD CATERPILLARS.

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



CHEIMATOBIA BRUMATA.

Winter Moth. Winged male and wingless female; moth figured in act of walking, after Taschenberg.

On the 25th of November, the following observations were sent me by Mr. C. D. Wise, Superintendent of the Fruit Grounds of the Toddington Orchard Co., Winchcomb, Glos., which I have much pleasure in inserting, as they show the success which has followed on the measures for prevention of attack of orchard moth caterpillars. Also, as there are probably very few orchards of such extent as these, which, when last I heard enumeration of different kinds grown, required attention to 120,000 trees, the success of methods of treatment tried on this large scale is good in itself, and also a great encouragement for application of the same methods elsewhere.

Mr. Wise wrote:—"You will be interested to hear that we have decided not to grease-band our trees this year, having caught so few of the females of the Winter Moth during the past two or three years. It is of course no child's play here with our large number of trees, and we must rely on Paris-green in the spring should we find many caterpillars on our trees. I do not expect that we shall give up grease-banding altogether, but I look forward to doing it, say, once in three years. I should not for a moment recommend people who have only grease-banded their trees for the past two or three years to give

it up, but we have been grease-banding for six years, and I really think we have got the upper hand of the pest.”—(C. D. W.)

Those who have attended of late years to the prevention and remedy of attack of orchard moth caterpillars, will know well of what an immense amount of careful thought, and experiments, and adaptations of measures to meet each weak point in practical working, and also of steadiness in adhering to new methods of treatment, this success, both at Toddington and elsewhere, is the outcome.

So far as I am aware, from reports to myself, it was in the winter of 1883-84 that experiment in sticky banding was first tried with us on a somewhat large scale to stop the ascent of Winter Moths. This was done by painting the stems for the breadth of a foot or two with Gishurst's compound, by Mr. W. Charman, gardener to J. G. Strachan, Esq., of Farm Hill Park, Stroud, Glos.

This answered very well, but (as I said before), as far as I am aware, it was not until the great outbreak of destructive orchard caterpillars in the spring and early summer of 1888, that attention was drawn forcibly, and in many localities, to the need of more thorough measures of prevention. Care and preventive measures were taken previously, but an advance was seen to be needed.

On June 11th, 1888, Capt. Corbett (then Superintendent) wrote me from the Toddington grounds:—“The Winter Moth has indeed been bad here. We caught the moth by thousands with the band of tar and grease put on in October, and by renewing it lately we have caught numbers of the caterpillars; but for all this, the destruction is terrible.”

Successively it was shown that however well tar, or common grease, might do for occasional applications, or on the bark of old trees, yet that in modern arrangements of fruit farming, much less rough and haphazard treatment was required for the tender bark which was still alive and subject to injury from applications melting into it, which were liable to choke the cells.

To meet this difficulty experiments as to effects of different kinds of sticky or greasy smears were tried to find which were least injurious to the bark. These experiments being promptly followed by the improvement of application of the smear, not on the bark itself, but on a band of grease-proof paper, fastened round the tree on which the smear could be spread with little risk of touching the bark beneath.

By this means vast quantities of wingless moths were caught, but still the matter was anything but wholly met. Grease dried so that the banding ceased to be sticky; moths (where numerous) so choked up the sticky surface, that their companions passed in safety over their bodies, and, besides, many eggs were laid on portions of the sticky banding, or on dead moths, where these eggs could hatch in spring,

and eggs were also laid beneath protecting edges of the paper. Adding to this the difficulties arising from transport of the wingless females in connection with the winged males, and also from successive broods of Winter Moths, or other allied kinds occurring at variable dates from the middle of October until April, it was plain that even to meet this one matter of prevention of egg-laying of wingless female moths, something more was needed.

Unfortunately this, however, was *not* the only matter. Besides the caterpillars from these eggs, with the early summer there came hordes of other kinds, of which the egg-laying of the parents could not be even so well guarded against, and for which a sweeping remedy, such as could be applied when occasion required, was needed.

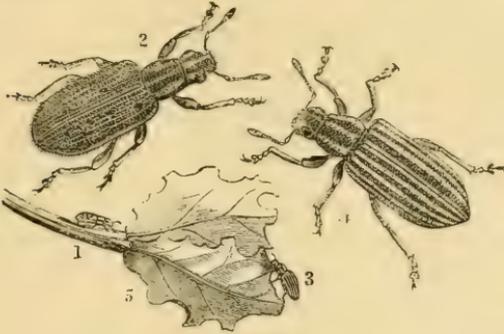
For this the use of spraying with Paris-green, which had long been serviceably adopted in the United States and Canada, was introduced; and with the help of a Committee of Experiment, formed of leading fruit-growers round Evesham, or in the neighbouring districts, the first difficulties regarding the introduction of this new application were got over, and its adoption secured.

Now, the various preventive or remedial measures are showing their effects in making their repetition to be much less called for, and it may be hoped that with these to fall back upon (and also with the continual increase of useful knowledge regarding different kinds of washes and implements for applying them), the orchard caterpillars will not again (where duly looked to) become such a devastating scourge.*

* Reports of methods of treatment found serviceable in prevention of orchard insect attack will be found in my 12th, 13th, 14th, and 15th Annual Reports of Observations of Injurious Insects. These orchard notes include, beside many reports from practical observers, notes of treatment based on the habits of the insects, recipes for bark smears, and methods of application, and, especially in the 14th and 15th Reports, notes from experimenters, and directions regarding use of Paris-green.—ED.

PEAS.

Pea Weevils. *Sitones lineatus*, Linn. (and other species).



SITONES.

1, 2, Spotted Pea Weevil; 3, 4, Striped Pea Weevil, nat. size and magnified; 5, gnawed leaf.

These Pea Weevils also attack Clover and Beans, and their work may be known by the leaves being eaten away from the outside. If the attack is not very bad, the leaves may be only scooped away, as if segments of circles were taken from the edge; but where it is severe, the mischief is carried on until only the mid-rib, or possibly only the footstalk of the leaf, is left. The beetles thus destroy the plants above ground, and underground the maggots feed at the plant roots.

These weevils may be sometimes found in vast quantities when Peas are being harvested towards the end of summer, and the attack is very common in gardens, but in the early part of the past season it was prevalent to an unusually destructive extent on the young field Pea crops.

Enquiries as to the nature of the infestation, with specimens of the weevils, and reports of the damage going forward, mostly to Peas, but in some instances also to Beans, were sent me frequently, and sometimes daily from April 7th to June 4th.

The attacks (as was to be expected) were mainly from the market-gardening, or especially Pea-growing districts, as from Sandy, in Bedfordshire, where the damage was very great.

Round Chelmsford, Essex, where Peas are largely grown for the London market, "scores of acres destroyed," and "great destruction in the neighbourhood," were respectively reported by different correspondents. In the district round Romford (in the same county) Peas were mentioned as having suffered terribly; destruction was reported from near Rochford, and near Southminster the attack was also bad. The infestation was also reported from Ipswich, in Suffolk.

Amongst other localities, severe injury was especially reported from the Pea-growing districts near Severn Stoke, in Worcestershire, and Alcester, on the edge of Worcestershire and Warwickshire, and in the latter case Beans were mentioned as being also attacked. The following are some of the details received.

The first notes sent commenced with information sent me on April 7th, by Mr. Edw. A. Cabberley, of Moor Hall, Alcester, Redditch, as follows:—"My Peas are much injured by beetles, specimens of which I send you. There has been no rain here for weeks, and the land is very dry. I rolled and harrowed the Peas a few days since, which I think has checked the mischief slightly, but the ground seems to be teeming with the insects. I intend rolling the field down firmly to-morrow. I may add that the attack appears to be general in this district, Beans suffering as well as Peas."

On the 8th of April the following account was sent me, also from the same neighbourhood, and also with specimens of the *Sitones*, or Pea Weevils, accompanying. In this instance most of them appeared to be of the species known, from the "stripes," or "lines," running along the wing-cases, as the "Striped Pea Weevil," scientifically as the *S. lineatus*.

Mr. John M. Moubray wrote from Broom Court, Alcester, on April 8th:—"I have five acres of Eclipse Peas, and they are being destroyed by an insect, and I send you some by same post. Could you kindly let me know how I can get rid of this pest? In a short time the Peas will be quite destroyed by them. I thought of rolling, but the Peas are very tender and would break."

In the following letter, written on April 14th, it will be seen that Mr. Moubray notices, besides the attack he observed on these Peas, that he knows of it on six other farms near:—"I note that the weevils are on the Peas, and in the ground close to them, but I cannot discover any in my other fields. I know six other farmers in the immediate neighbourhood whose Peas are attacked in the same way, and some of them have already ploughed up the crop."

On the 19th of April, Mr. H. E. Thornley, writing from Radford Hall, near Leamington (about $16\frac{1}{2}$ miles E.N.E. of Alcester), reported the destruction going forward. In this case the specimens sent appeared more to resemble the Spotted Pea Weevil, the *S. crinitus*, which is rather smaller than the "Striped" kind, and has the wing-cases spotted with black. Mr. Thornley wrote:—"I am a grower of large quantities of Peas; at this season they are being entirely spoilt by these beetles, so much so that I have decided to plough one field up."

From Croome Court, Severn Stoke, Worcestershire, I was favoured with the following note on April 21st. (This locality lies about 7

miles south of Worcester, and is also a Pea-growing neighbourhood):—“A most destructive insect, hitherto little known here, has made its appearance in large numbers in this district, and attacks the Peas, which are just coming up. It bites the leaf first; afterwards the stem. Early Peas are much grown in this neighbourhood, and I am informed that many acres have been destroyed by the ravages of this pest.” And on the 23rd the following additional notes were sent to me:—“From what I can gather the beetle is not unknown in the neighbourhood, but its ravages have never been so serious before. It appears to attack the white Peas in preference to the grey variety, and it has destroyed many acres.”

The greatest extent of damage reported was, however, from Essex, and the first note of the infestation being severe there was forwarded to me on the 26th of April, by Mr. James C. Smith, from Sandford Mill, Chelmsford. The specimens in this case were of the “Spotted” Pea Weevil, with perhaps some of the “Striped” species amongst them. Mr. James Smith wrote as follows:—“In this neighbourhood there are large quantities of Peas grown for the London market. This year they are attacked, and scores of acres quite destroyed by a small brown insect, three-sixteenths of an inch long. They are extremely difficult to find, as when you approach near they drop off the Peas, and then are so exactly like little pieces of earth that they quite escape notice, unless very carefully searched for. Will you kindly say anything you can suggest for a cure? I have not yet ploughed up my Peas, as the stumps are still alive, eaten off to the ground, but several of my neighbours have done so.”

On the 30th of April, Mr. J. Smith wrote further:—“We are trying soot, &c., in a small way in the garden, but the crop has so nearly disappeared in the field, that it is not worth the heavy expense the dressing there would entail. The infestation is very bad about here this year; nothing like it known before, of late years at any rate. I presume it is chiefly due to the excessive cold checking the growth, and enabling the little creatures to devour the plant bodily.”

From Stubbers, near Romford, Mr. Champion B. Russell wrote on the 2nd of May:—“Just one line about the *Sitones*. The Peas in my garden are quite free, but the farmers around have suffered heavily. Most of them have imagined it was ‘slug,’ and have limed vigorously, but not always when the leaf was wet.” . . . “I think that all I saw were *S. crinita*.” . . . “Many of my neighbours have ploughed in their Peas.”

Two days afterwards (on the 4th of May) very characteristic specimens of injured Peas, together with *Sitones* weevils, apparently *crinitus*, were sent me from Maylands, Hornchurch (also near Romford), by Mr. Collinson Hall, with the observation that they were specimens of

“some beetles which have caused sad havoc with the early Pea crop in this market garden district.” Somewhat later, on the 13th of May, Mr. Collinson Hall further mentioned:—“In this district a large quantity of the earliest Peas have been nearly destroyed. I have had to plough up eight acres, and I find another piece which is heavily manured is looking better, and now getting the better of this pest, for they seem to have left this piece, and are now on the early Broad Beans, and it looks as if they like this crop best, for all the leaves, as well as the stock, are perforated and turning black. I have tried soot and also lime, but they are as numerous as ever.”

From Doggetts, Rochford, also in Essex, the following communication as to unusual amount of prevalence of this attack was sent me at the beginning of May, by Mr. W. Meesom. The weevils, of which specimens were sent, were mentioned as “causing great injury to our blue Pea plants ‘just coming up.’ Some of the earlier sown fields are apparently quite destroyed by them, eaten quite off. Have been a large grower of Peas for many years, but have never lost the plant from this cause before. No doubt you will be able to inform me if this insect is a fresh importation that we have to contend with.” This note was sent on the 2nd of May.

Various communications were sent during the month of May by Mr. W. Dannatt, of Margaret’s Woods, Great Waltham, Chelmsford, relatively to this attack, and to some serviceable notice of its unusual prevalence, in the local press.

Mr. Dannatt’s first observations, sent on May 4th, were as follows:—“I send some specimens of a weevil which are causing great destruction to the Peas in this neighbourhood. I have twenty-five acres of early sown Telegraphs, some plants of which I also send, which you will observe are well rooted and perfectly healthy, but completely mastered by this pest. And if I am not troubling you too much I shall be very much obliged if you will give me some information respecting them, *viz.*, whether the Peas are likely to overcome them should warm growing weather set in? Are they likely to continue to attack them up to the time of picking? If left are they likely to increase and become a pest in future years?”—(W. D.) (These questions, which are all important practically, I attended to to the best of my power at the time, and they will be found noticed a few pages further on, under the head of “prevention and remedies.”—ED.)

On the 10th of May, amongst other points, Mr. Dannatt noted, with regard to possibilities of difficulties of cultivation in the previous autumn having left much of the winter shelter of the weevils untouched, that this “would not apply in this case, as the land was steam cultivated in September 8 inches deep, followed by steam

harrows twice in a place, which left a fine deep tilth of about 10 inches. Farmyard manure was carted on, and the land horse-ploughed during very sharp frosts."

The enquiry of Mr. Wm. Sewell, in the following note sent from Tillingham Hall, Southminster, Essex, as to whether the weevils (of which he forwarded specimens) were the same kind of which many were seen in harvest time, touches on a point which I have endeavoured always to keep forward as a certain means of lessening amount of recurrence of attack, and which is now noted a little further on. Mr. Sewell observed:—"I enclose you some insects to look at; they are eating the Peas this year very much, in many cases nearly destroying them, particularly the early ones. Are they the same we get a good many of in harvest time with the Peas? They have never attacked them at this time of year."

Other notes were sent, as from the district of Sandy, in Bedfordshire, from which, amongst other observations, I had, on the 10th of April, a note from an observer desiring information regarding these beetles, which he mentioned, had attacked his winter Beans, just coming up, sown in February, and threatening to ruin the crop; and the forecast was confirmed by reference of another contributor (on the 10th of June) to this district as "the scene of the havoc of the Pea Weevil."

Two of the kinds of these weevils which are commonly found doing mischief are figured, both natural size and magnified, at p. 107. These are the *Sitones lineatus* and *S. crinitus*, and are often quite indistinguishable from each other by reason of the markings being rubbed off the wing-cases, so that they only look of a kind of patchy black.

When fresh and in good order the *S. lineatus* is of an ochrey or light clay colour, with three lighter stripes along the back, and ten *stripes*, alternately lighter and darker, along the wing-cases. The *S. crinitus* is rather smaller, more of a grey or rosy tint, and the wing-cases are *spotted* with black.

Another kind, of which the whole life-history has been more especially worked out with us on Clover, is the *Sitones puncticollis*; this is a little larger than the "spotted" kind, greyish or fuscous (until the scales are rubbed off), and distinguishable by having a few light dots on each side of the central light line which runs from the head to the wing-cases in this as well as in the two above-named species.

The method of life is for many of these weevils to live through the winter, and wake up from their winter torpidity to come out and attack the crops in spring. But it is not only these hibernated weevils that do the mischief. They are joined in it by the weevils which develop at the beginning of June (earlier or later as the case may be) from the

maggots which have been feeding during spring at the roots of the Peas or Clover.

The maggots, of which I have received specimens, were about a quarter of an inch long when full-grown; whitish, plump, and much wrinkled; without legs; the head brownish or ochrey in colour, with strong jaws. Fig. 3, p. 37, gives a very good idea of the appearance of the maggot (much magnified) of the Dutch Clover Weevil when lying at rest, but at pleasure they can extend themselves, so as to appear narrower and straighter.

The mischief caused by the maggots is often not suspected, but nevertheless this maggot gnawing below ground is at times so severe as totally to ruin the plant, even to the extent of necessitating ploughing in.

Towards autumn, when the Peas are being harvested, great quantities of the weevils may be seen, and these lay the foundation for the next year's attack. By the end of November, maggots are noticeable in all stages of growth at the infested roots, and they may be found in December and January still in larval state. Early in April some of the larvæ cease to feed, and early in May may be observed to have formed hollow earth chambers, in which, towards the end of that month, they turn to chrysalids, from which the summer brood of weevils begins to appear in June.

PREVENTION AND REMEDIES.—Judging by the replies which have been kindly sent me in reply to special enquiries, and also by search into reports of previous years, very little indeed can be done by the common methods of remedial treatment, as rolling, hoeing, dressing with soot, and the like. But still some of the observations of what did *not* do good may be of service in saving expense in experiment; and also, if the partial success of some of the experiments are joined to consideration of the habits and nature respectively of the insect pests, and the attacked plants, some leading points may be worked out.

The first attack appears to be from the *wintered beetles*, and if the ground is merely re-sown, after the crop has been swept off, these same beetles will, I believe, go on eating up each successive crop till it is time for *them* to die off.

The new brood of beetles, as far as we know, does not come out till June. Therefore, if when one crop is destroyed the ploughing could be so arranged, as will be found fully detailed in the following observations, there would appear good hope that the pests might be buried down, and the loss (bad as it is) not be extended beyond the first destruction.

In the following note with which I was favoured on the 19th of November, in reply to my enquiries, by Mr. Edw. A. Cabberley, of

Moor Hall, Alcester, near Redditch, it will be seen that he first notices various measures *not* found of service, and then it will be observed how thoroughly the surface was turned to the bottom, and the piece after sowing heavily rolled down.

Mr. Cabberley wrote:—"I regret that I found no remedy myself, neither did I hear of any that proved effectual. I planted 16 acres of Peas, 11 of which were early, and 5 a later kind. The 11 acres were totally destroyed. I found no benefit from harrowing and rolling, nor yet from applying soot. It is true, however, that in this case there was little or no leafage for the soot to adhere to, the weevils having eaten off the Peas, stems as well as leaves, level with the ground. These Peas throw up a second and a third shoot, only to be grazed off in a similar manner. By this time the end of April had arrived, so I ploughed up the 11 acres, carefully turning the surface into the bottom; drilled the whole piece again with 'Prince of Wales' and 'Duke of Albany' Peas, and heavily rolled it down. The Peas were through the ground in ten days, and I do not think *a leaf was touched by the weevils*, although at the same time they were working at the adjoining 5 acres of late Peas, which had then been up three weeks. The attack upon the 5 acres was not so severe, the Peas getting well into leaf before it commenced. These were drilled in rows a yard apart, and I sowed soot thickly along them in the dew; yet the weevils were upon the leaves in the afternoon, though the soot was adhering thickly to them at the time. I do not think the dressing had any effect.

"I had a piece of Vetches in another field which appeared above ground at the same time as the early Peas, and these too were devoured, yet the adjoining lands coming up a little later were not touched.

"I noticed that a heavily laden cart which passed over scores of the weevils did not appear to injure one of them. When the attack was at its worst the ground was very dry, at the same time the days were hot and sunny, and the nights frosty.

"I believe nearly all the Peas (in this district) which were then above ground were totally destroyed, whereas those that came up a little later were less seriously injured, or escaped altogether."—(E. A. C.)

The following letter sent me by Mr. James C. Smith, from Sandford Hall, Chelmsford, giving on the 26th of November an account of the completed observation of the infestation, also shows the general uselessness of the remedies tried, and the non-benefit of rolling. Also the destruction of one sowing after another, and the great area of serious damage, namely, 1000 acres. But there is the important point noticed that the Peas sown on the 16th of May overgrew the

attack. This point is well worth notice, whether it might be from the brunt of the attack being past, or circumstances of plant-vigour pushing the plant-growth into safety. Mr. J. C. Smith wrote as follows:—"In reply to yours as to the Pea Beetles, I am sorry to find that I cannot hear of *any* of the various remedies that were tried last spring being of any practical use.

"Wherever they appeared thickly on a field, this was almost always completely spoilt. In my own case I did not plough the remains of the crop up until about the 12th of May, thinking that, as the Peas were a late variety, and a very strong growing sort (Telegraph), when the beetles left them, the stumps, which looked very green, would shoot again; but it was no use whatever. On May 16th I re-sowed the same ground with Peas, and these also the beetles began, but they grew so vigorously, that with the last crop the conditions were reversed, and the Peas gained the day. The beetles are so *hard* that rolling the land is of no use.

"In this neighbourhood I might safely say 1000 acres were seriously damaged, if not utterly spoiled. One field close by was sown *three* times, and *every* time eaten up."—(J. A. S.)

The following observation, by Mr. Thornley, from Radford Hall, Leamington, of the beneficial effect of dressing with nitrate of soda and soot, is almost the only note of successful remedial application, and here (conjecturally) a good deal of the benefit would be from driving on a good growth, besides what protection might be given by the soot to the leafage. Mr. Thornley, in reply to my enquiry, wrote me:—"The most effectual remedy I found for the Pea Weevils last spring was small and repeated dressings of soot and nitrate of soda, applied in the early mornings when the dew was on the leaf. One piece of five acres of Prince of Wales Pea I dressed just as the Pea was making its appearance; then repeated the dressing in a week's time when well through in rows. That was my best crop by far. My opinion is the remedy should be applied before the weevils make their appearance."

In another communication (sent me from Sandy, Beds.), the writer also mentioned that he "did not find any benefit from dressing with soot the piece of winter Beans which was infested with *Sitones lineatus*. The plot was sown in late autumn, and was much more seriously damaged than one adjoining, which was sown in the spring."

Looking now over the reports of the past season and previous years, they all appear to point to any "remedies"—that is, any measures specially directed to getting rid of the weevils when once they are on the plants—being of little or no good. Dressings of soot, or soot and lime, applied when the dew is on, may be expected to be of use in garden service, where they can be given with minute care and in very liberal amount. But this is very different to a paying field application where the material is costly, and also it would disturb farm service to

put a sufficient number of men on a good acreage to get the plants dressed whilst the dew remained on.

Rolling does not injure the beetles, and unless there is a good thickness of soil rolled hard down above them (as mentioned in the note of Mr. Cabberley at p. 113) they will in all probability soon make their way up again.

The only available methods of checking the attack seem to be forestalling it. The weevils are in some years to be found in *enormous numbers* where they can be swept together and destroyed during harvesting operations, as on the "reapers," and in the Pea waggons. Sweeping these up and destroying them would get rid of a definite quantity of future mischief. If left, some live through the winter in various shelters, but notably in stubble. We have observations of the total loss of *Trifolium incarnatum* from this cause where the *Trifolium* was drilled in stubble. On examination the beetles were found sheltered in the top joint of the stubble, and on this observation being followed up, and the stubble skimmed, so as to get rid of it as a beetle shelter, it was believed the trouble was lessened.

The beetles have also been found in January, where they had apparently come out from their shelters in Barley stubble. These and similarly sheltered hybernating beetles start the attack; but a portion of those which might be really got rid of in harvest time do mischief in another way: they lay their eggs at the roots of Clover, or other crops suitable, and, firstly, from the maggots from these eggs working at the clover-roots, and, next, by the beetles to which these maggots turn, furnishing the summer brood, attack is set up, of which the origin might with little difficulty have been destroyed in the previous year,

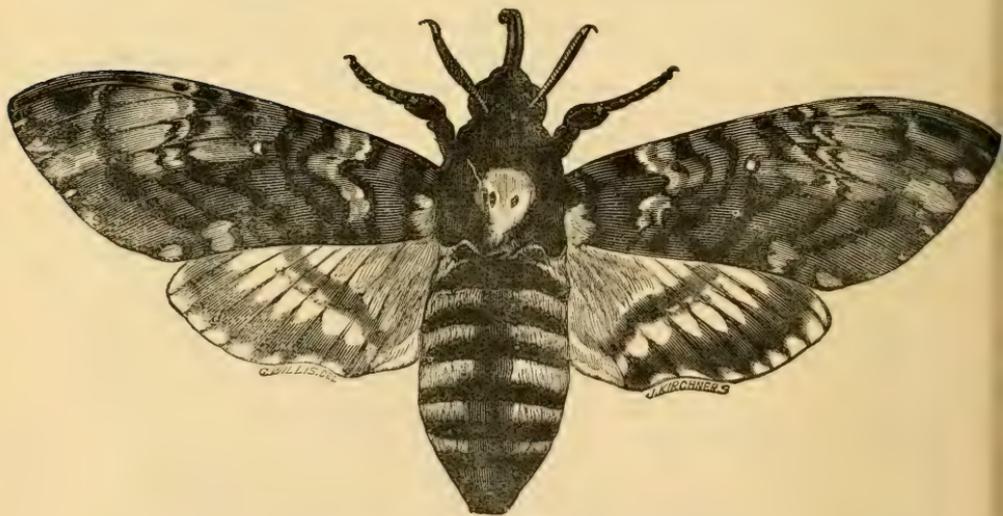
In most insect attacks, keeping up the strength of the plant is a great preventive of loss, if not of insect injury; but in this case the little Pea plants are so small, and with so few resources in themselves, that this principle is not always to be relied on. With root crops, as Turnips or Mangolds, there is a store of food to draw on, which often restores a crop even when eaten back to an almost hopeless state. But with the Pea crop there are only the stringy fibrous roots to draw on, and so far as experiments show, if the crop becomes leafless, it cannot be trusted to, to recover.

So long as there is some amount of leaf (as in the experiment noted at p. 114, where nitrate of soda and soot were used), strong stimulant may push on leafage faster than the beetles gnaw it off, but otherwise the dressings seem of very little use. But so far as can be managed, it appears to be the hearty growth of the Pea which is the mainstay in attack, joined in some cases to date of growth being when the first outburst of beetle has taken place, and before the second set come towards June.

In looking over notes, recent and previous, it appears that sometimes a strong hearty Pea will carry well through attack when a weaker one fails, and every detail of cultivation which will tend to cause rapid replacement of leafage will necessarily be of use, but at present we seem to have no "remedy." Whether this state of things needs still to continue remains to be seen. There would not be (so far at least as I am aware) the difficulty with the young Pea crop that there is in many cases of taking a horse implement like the Strawsonizer over the ground; and, if so, it would probably very soon be found that some of the applications, so frequently enumerated in these pages that it is unnecessary to go over them again here, would act both effectively and at a paying rate.

POTATO.

Death's-head Moth. *Acherontia atropos*, Linn.



ACHERONTIA ATROPOS. Death's-head Moth.

The great caterpillars of the Death's-head Moth are not very unfrequently met with, although they are not common, and rarely occur to a really injurious extent. When full-grown they are four or five inches in length, and as thick as a man's finger; usually of a

yellow or yellowish colour, green towards the head, and granulated and speckled with black on the back. On the sides are seven oblique lateral stripes, meeting on the back, the lowest end pointing foremost, the colours being blue, with some white and lilac. At the tail is a horn-like process bent down, and turned up again at the tip, and tubercled on the surface. The figure at p. 118 shows a specimen not yet fully grown.

There is a variety of a brownish olive colour mentioned by Stainton as occurring "sometimes, but very rarely," which I have once had a specimen of.

The caterpillars usually feed by night on Potato leafage, and last year, as in others (when sent at all), the attack has been so little represented that it would not be worth mentioning again but for the splendid size of one moth sent me.

This was forwarded to me at the beginning of October, per favour of the Editor of the 'North British Agriculturist,' from a Wigtonshire correspondent,* as a rare insect, with remarkable powers of emitting sound, or, as it was phrased, "in full voice." On examination I found the specimen was a Death's-head Moth in most beautiful condition, and the very largest of the species that I have ever seen. This moth is our largest British kind, and is given by various writers as from four to five, or even over five, inches in the spread of the wings. The fine specimen figured at p. 116 is just under five inches, but the one sent to myself being larger still, by measurement fully or upwards of $5\frac{1}{4}$ inches in the spread of the fore wings, it seems worth while to record the observation of such a very fine specimen.

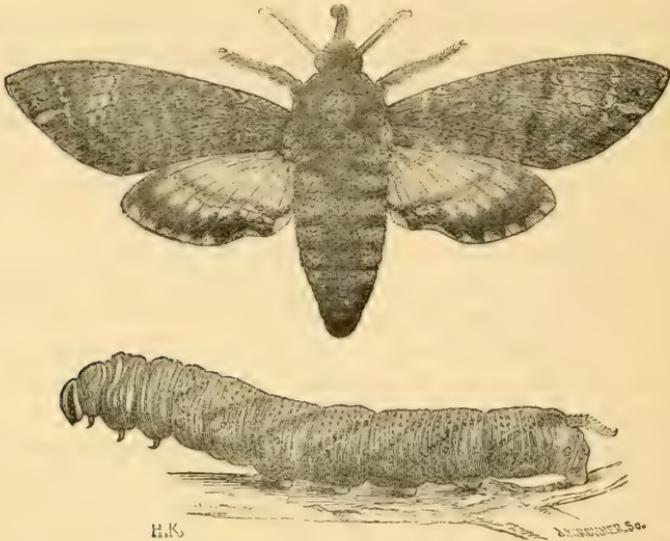
The Death's-head Moth is very richly coloured. The fore wings dark brown, with various black and rusty, and also some ochrey bands, wavy lines and other markings. The hind wings orange, with a broad black band near the outside, and a narrower one within. The abdomen is also orange, with black cross stripes, and a row of bluish spots, or rather perhaps a kind of lead-coloured band, down the middle. The head, and body between the wings, brownish black, and on the back is a pale skull-like marking. Altogether it is a magnificent insect, and from the so-called "Death's-head" on the back, and also its power of emitting a very audible noise like a low squeak, or cry, on annoyance, has at times caused a good deal of superstitious alarm.

Another name of this moth is the "Bee Tiger," from the propensity ascribed to it of entering bee-hives, and robbing the Bees of their honey, which certainly stands recorded on trustworthy authority, but I have never met with an instance of it myself. Possibly the great alteration in the method of Bee-keeping at the present date, in boxes

* For account see number of 'North British Agriculturist' for Oct. 5th, 1892.

and various apparatus often taking the place of the straw hive of former days, makes the outside of the hive less attractive, and the opening much less commodious for entrance of the moth.

If the moth should be found troublesome in this way, reducing the size of the Bees' entrance doorway is the obvious and regular remedy. If the great caterpillars are found to be doing mischief to Potato



Death's-head Moth, also caterpillar not yet full sized.

leafage, they should be looked for under the surface earth, or sheltered from light by day, and from their great size would be easily distinguishable, even in the moonlight of August or September, when at their night feed.

But excepting as matter of curiosity or interest from their great size, the Death's-head Moth and its caterpillars are rarely noticed in this country.

Frosted Orange Moth. *Gortyna flavago*, Newman.



GORTYNA FLAVAGO. Frosted Orange Moth.

The caterpillars of the *Gortyna flavago*, or "Frosted Orange" Moth, feed within the stems of various strong growing plants, as the

Burdock, Mullein, Thistles, Foxglove, and sometimes within Potato-stems. In these last, which are the only places in which I have myself had the opportunity of observing the attack, it causes the complete destruction of the infested stem. The caterpillar eats away a considerable length of the soft inside tissues, so that presently the stem breaks, or drops down above the injured part, and all this portion is killed.

As yet we have not been able to rear the moths from these Potato stem caterpillars, but as they agree in points of appearance and locality, and method and date of feeding, with those of the *G. flavago*, it seems scarcely open to doubt that they are the grubs of this sometime troublesome kind.

One of the samples of infested Potato haulm was sent me from Melton Mowbray on June 15th; this was merely accompanied by enquiry as to the nature of the attack.*

A much more detailed observation was sent me on the same day by Mr. D. Taylor, junr., of Daleally, Errol, N.B., with specimens accompanying. In this instance the Potato stem was badly eaten away within. Mr. Taylor wrote as follows:—"After writing last night, I happened to go past the garden of my foreman, and observed a number of his Potato shaws drooping as if they had been cut or broken. We cut them over below the drooping part, opened one or two of the stalks up, and found the cause of the sickness to be a worm of some sort, which had entered by eating a small hole, and feeding its way up or down the inside of the stalk; and in one case, as you will see, the leaf stalk is affected." . . . "This is surely a new Potato pest? I have never seen Potatoes fallen in this manner, and it is only one side of the garden that is as yet affected."

The caterpillar is soft, cylindrical, and may be generally described as of a kind of putty colour, varied with a good deal of pinkish on the back, and the segment behind the head and the tail segment black, or with the horny plate on the upper part of each black or dingy brown. The body is rather attenuated at each extremity, with a number of brown or black dots, each bearing a bristle. The head yellowish brown, and rather smaller than the next segment.

These caterpillars are stated by the late Edward Newman (who gives in his 'British Moths,' pp. 279 and 280, the best account of this infestation with which I am acquainted) to be found full-fed in the stems of the tall Marsh Thistles, in which he specially observed them, early in July. "When about to change it prepares a means of escape by gnawing away the substance of the Thistle stem, leaving only the

* See reply to enquiry in 'Agricultural Gazette,' number for June 20th, 1892, p. 577.

most slender and delicate epidermis, which always remains intact, and then changes to an elongate, cylindrical, smooth, dark brown chrysalis."—(E. N.)

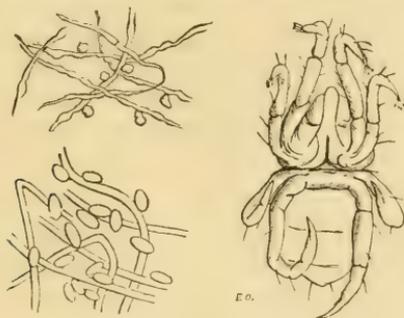
The moth measures about an inch and a half in the spread of the fore wings, which are of an orange yellow, variously marked with rich brown or purplish. Near the base of the wing is a reddish brown bar, and succeeding this are three markings, known as the *stigmata*, thus described :—"The inner one small, round, and pale yellowish buff; the outer one larger and ear-shaped, mottled with red scales within; the supplemental one semi-oval, all being surrounded with slender reddish brown lines."—(J. O. W.) Nearer the tip of the wing is a purplish bar, followed by a much waved narrow stripe formed of small fulvous arch-like markings. The great variety of marking on the wings makes it almost impossible to describe them intelligibly, but the figure gives a fair idea, with the explanation that the lighter colours are mainly yellow, and the darker markings of some shade of reddish brown or purple. The hind wings are pale brown or somewhat ochrey, with a stripe across near the middle.

This infestation, though the moth is now a very common one in this country, is very rarely reported as injurious to Potatoes, and in the attack last year at Daleally it was only to a small quantity of the stems (or "shaws" to use the local word) on one side of one garden. Still the caterpillar, if it does get possession, is so certain to ruin the attacked stem that it is as well not to let its workings pass unnoticed.

The presence of the grub may be known by the fading of the tunnelled stem, and then without delay each of the stems should be cleared, and the caterpillar, if the attack is only on a small scale, looked for and destroyed. This is desirable, as the grub may very likely be low down in the stem, or may, as found by Mr. Taylor in his examinations, have gone down from the stem tunnel into a tuber. But if the destroyed stems and their contents are got rid of before the time of appearance of the moth from the chrysalids, there will be little fear of recurrence of the trouble.

RED SPIDER.

Red Spider. *Tetranychus tiliarum*, Müll.; *T. telarius*, Claparede.



TETRANYCHUS TILIARUM.

Red Spider of Lime trees (nat. size, microscopic); web with eggs in dried state, and after being moistened; all enormously magnified.

The Mites, or *Acari*, commonly known as “Red Spider,” are an infestation which is prevalent on so many kinds of plants, notably on Hops, leafage of wall fruit trees, besides many others, as leafage of French Beans, &c., that it is perhaps most convenient to notice them under their own popular name. In the present instance I only allude to them as having been again noticed as a seriously injurious attack to Lime trees, and also on account of a soft-soap and sulphur compound having been found to answer in getting rid of them.

These Mites belong to the division known as the “Spinning Mites,” from their power of spinning a web over the surface of the leaves, or even the trunks of trees, which may be infested by them. This web is woven of such exceedingly fine threads, that it either does not show at all (unless examined through a magnifying-glass), or else only shows as a kind of silky lustre, or glazy appearance on the leaves or trunks of infested plants or trees. But it is the web (figured from life at heading) which makes the great difficulty in dealing with “Red Spider.”

The threads are so interlaced that they form a very protecting shelter, to which the eggs can be attached as figured, and which helps also to secure the Mites from injury. When fully developed these Mites have four pairs of legs, and are of an oval shape, with head, body, and abdomen forming one solid mass. The head is furnished with an apparatus of beak or sucker, and minute nippers, by means of which it draws away the juices from the attacked plants, and causes the mischief which we know only too well. Near the end of the tail is a minute protuberance from which it produces its threads, and at the

tips of the feet are a few processes, like excessively fine pin-headed bristles, which help these "Spinning Mites" in arranging their webs, and in holding firmly to them.

Whether *the* "Red Spider," best known as seriously injurious to Hops, and scientifically named *Tetranychus telarius*, is precisely the same as that of the Lime tree, and which also infests French Beans, and is named (from the first-named habitat) *Tetranychus tiliarum*, is a point on which there is some difference of opinion amongst specialists, but does not appear to be of importance for practical service. The main characteristics of the Lime tree attack are the quantity of fine web spun over the trunks and branches of the trees, and also on the under side of the infested leaves (thus giving the shiny appearance mentioned above to the large area of webbed surface), and also the enormous numbers of the Mites which are sometimes to be found heaped up in yellowish masses round the base of the trunks of the trees.

One instance of very severe attack to Lime trees was reported to me some years ago, but otherwise I do not remember hearing of it as a serious matter until the two following observations were sent me in the autumn of last year (1892).

On the 22nd of September, a note was sent me from Springfield Place, near Chelmsford, by Mr. Thomas Jackson, in which it will be seen that the above characteristics, that is, the masses of Mites round the bases of the trees, and also the shiny, or slimy, appearance of the trees, are especially mentioned. Also the injury to the leaves is noticed, which is sometimes very great, or total ruin, for the Mites are known to congregate so thickly (chiefly) on the lower side of the leaves that the leafage is yellow over with them, and the mischief caused by the great quantities of the punctures, and also consequent loss of sap, causes the destruction of the leaves.

Mr. Jackson wrote, on September 22nd, that he was sending "some specimens of a blight which has attacked some young Lime trees here. At present the old trees, of which there are some very fine ones, are not affected; those that are, being about ten inches in diameter, a foot from the ground.

"He cannot be quite certain if the blight begins from the stem nearest the ground, or from the foliage, but the form it takes is as follows: there is a band of yellow colour on the ground round the stem of the tree, about an inch broad, resembling somewhat a piece of gold-lace; this is a mass of living creatures, very minute, which spread all over the bark and branches, which are covered with a kind of cob-webby slime, like the trail of a snail, and the insects cover the leaves, which soon wither away."

Mr. Jackson further noticed that his gardener had tried Gishurst soap and water, mixed with petroleum and quassia chips, with other remedies, but all seemed of no avail.

About three weeks later, that is, on the 11th of October, enquiry was sent to me by Mr. Samuel Berger, of Bragbury, Stevenage, regarding the nature of an attack of which specimens were sent accompanying, which proved to be of "Red Spider," clustered in great numbers on leafage and other material, in the sample package sent.

Of these Mr. Berger remarked, "They have attacked three Lime trees in an avenue of about thirty trees. The trees in question are all affected on the same side facing east, and only on that one side. The appearance of the trees on the side affected is as if they had been varnished, quite smooth and glistening."

Here again it will be noticed the peculiar shining or glistening appearance of the attacked surface is mentioned. There is much variety in colour, or shade of colour, of the so-called "Red" Spider, which may run from yellowish white to orange, or different shades of red; but in the case of the Lime "Red" Spiders which have come under my own notice, the colour has appeared to me to be of some tint of yellow. The specimens sent me by Mr. Berger were of a good orange or yellow colour.

Looking at the point of sulphur being one of the regular applications used by Hop growers for destruction of "Red Spider," and also of the serviceableness of soft-soap wash in adhering, and so choking up the fine webs, together with the contained eggs and Mites, I suggested trial of the "Chiswick Compound" (noted at various places in this Report); and in a note from Mr. Berger, sent on the 13th of October, he mentioned that he was, that day, having the trees sprayed with a solution of soft-soap, but that as soon as he could get some of the compound named, he would have them dressed with this, and would let me know result of the treatment.

On the 16th of Nov., Mr. Berger favoured me with the following satisfactory report:—"We have found the 'washing' of our Lime trees with the Chiswick Compound you recommended, has got rid of the *Acari*. The soft-soap wash sprayed from a garden engine was not nearly so effective."

From the above observation the soap and sulphur compound seems to meet the difficulty as well as could be wished, but if instead of purchase, it should be wished to prepare a somewhat similar mixture on the premises, the difficulty of dissolving the sulphur may be got over by using sulphuret of lime.

The following is a serviceable recipe:—Take four ounces of sulphuret of lime, and two ounces of soft-soap, to each gallon of hot water, the soap and sulphuret to be well mixed, and the hot water then gradually poured on, the mixture being well stirred whilst this is done, and used when cool. This may be used for spraying, or well rubbed on to bark; but I believe the "compound" mentioned

above is both cheaper and better. References will be found to it in the Index, under the name of "Chiswick Compound."

Where the Mites are observable, as in the case of this attack, and also in that of Hay Mite, collected in great masses on the ground, all common sense measures (which will suggest themselves) will be desirable for shovelling them up, or otherwise collecting them, and destroying them.

STRAWBERRY.

Strawberry-leaf Beetle. *Galeruca tenella*, Linn.

The *Galeruca* (or as it has recently been called, the *Galerucella*) *tenella*, is a very little beetle, only an eighth of an inch, or slightly more, in length, which was observed last year doing much harm in one district to Strawberry leaves. The beetle may be easily identified from description with the help of a fairly strong magnifier. It is oblong-ovate, and convex in shape, and the general colour is of some shade of dull yellow, or brownish. Looked at more minutely, the head is yellow, with a broad black stripe or band across the top. The thorax or fore body also of some yellowish tint, with, in some instances, a dark line along the central furrow, and on each side of the furrow is a small round depression. The wing-cases pitted, so as to be slightly granulated, on the surface, and rather shiny, and in the specimens sent somewhat variable in colour, sometimes yellowish, sometimes of a brown tint, with the margin and the suture yellow, and occasionally a spot on the shoulders of a dark brown. The body black beneath, with the tip of the abdomen pale; legs pale; and the horns long, palest at the base, black towards the end.

This kind is recorded as being found "in this country in July, frequenting Willows, Alders, &c.;" and in Germany it is mentioned by Kaltenbach, as being repeatedly noticed by himself on young plants of *Spiraea ulmaria* (Meadow Sweet), and "once in greater numbers" on the *Potentilla anserina* ("Silver Weed" with us), of which it greatly damaged the leaves by its gnawings.

The *Spiraea*, and still more the *Potentilla*, are nearly allied to the Strawberry, so that it is not surprising that it should be found on this plant; but still, until the observation of it was sent from Hants, I was not aware of it having been noted as a Strawberry pest. Plentiful samples, both of the beetles and of the injured leaves, were sent; and

as the attack was new to me, I availed myself of the skilled assistance of Mr. Oliver E. Janson, F.E.S., of Perth Road, London, N., in identification, in order that we might be absolutely certain of the species.

The specimens were sent me on the 27th of July, by Mr. G. Messem, from Hundred Acres, Wickham, Hants, with the observation that they were insects which were destroying the Strawberry plants in that neighbourhood. It was considered to be a new pest in the locality, and any information as to how to destroy it was greatly desired.

So far as had been observed, the beetles were believed to lay their eggs on the under side of the Strawberry leaves, from which presently the grubs hatched out, followed in due time by a second brood of beetles, but the progress of development had not been worked out with precision.

The following short note given by Dr. Ritzema Bos, conveys the general life-history of the genus :—“ The beetles and the larvæ feed on the leaves of the same plants ; the pupæ are to be found sheltered in cocoons in the ground.” *

In Rye's 'British Beetles' (p. 212, edition of 1890), it is observed of the *Galeruca* :—“ Their larvæ, which are sluggish, rather elongate, wrinkled, and with lateral tubercles, and an anal projection, serving as an extra leg, live in company, and commit great ravages, often stripping every leaf off the trees, &c., on which they feed.”

The injured Strawberry leaves sent clearly showed the great mischief caused by the attack. These were perforated in some cases with irregular shaped holes right through the leaves, and still more injury was done by little patches of the outer skin of the leaves being eaten away, leaving the veins, but quite destroying the attacked parts.

The harm done (as shown by the specimens sent) was quite serious enough to make it worth while to give attention to keeping the attack under. So long as the fruit is on the plants, it does not seem possible to use any measures to get rid of the pests on the leafage ; but so late in the season as the 27th of July, in warm localities, this would probably not be a difficulty. In such case picking off as much of the grub infested leafage as was much injured would be a very desirable course. Also strong dressings, as of “ Fisher Hobb's ” mixture (see Index), or hellebore, which, in this case, might be used without fear of poisoning eaters of the fruit (a difficulty occurring in careless use in connection with green Gooseberries), would be likely to be very useful. Also, as it is the habit of the grubs of the *Galeruca* to go down into the ground to turn to chrysalids in cocoons, it could not fail to do good to treat the surface soil beneath the Strawberry leafage in summer in such a

* ‘Tierische Schädlinge und Nützlinge,’ von Dr. J. Ritzema Bos, p. 363,

way as would get rid of the infestation, and so forestall the development of a second brood of beetles. Where date of gathering the fruit crop allows, and it is the custom to clear the leafage of the plants after the fruit is picked, this would afford great facilities for dealing with the infestation, whether on the leaves or in the ground.

Judging from the notes sent, though the fact is not clearly stated in form with date of appearance, &c., there is a second brood, and if so this should be looked for, and got rid of in hibernating state from beneath the Strawberry plants during winter. The beetles would in all probability be found, as is the case with a nearly allied species, harbouring in the leaves and rubbish on the surface, and if this was scraped together and burnt, before disturbing the surface soil for the customary winter treatment, a deal of infestation would most likely be got rid of. Clearing the surface is needed as a preliminary operation in a case of this sort, as otherwise many of the beetles, whether of this or of other kinds which are only lightly buried in the rubbish in which they were sheltering, are in no way injured, and in due time come up again strong, and ready again to do mischief.

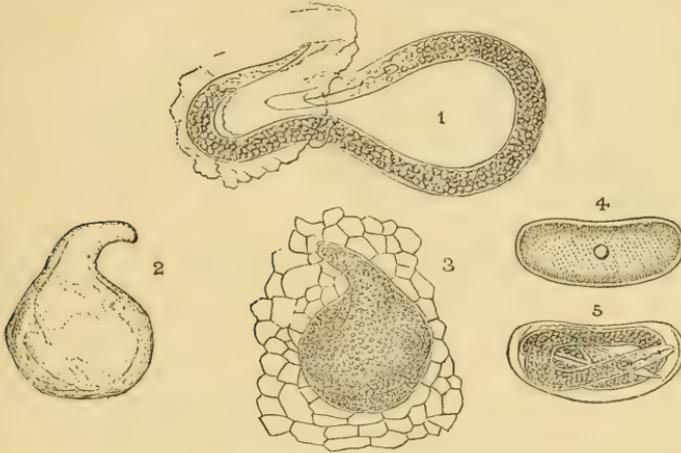
Observations of whether the common food-plants of this *Galeruca*, namely, Willows and Alders, were in the neighbourhood, and also the Meadow Sweet, which is a very common plant by ditches in many localities, and taking any measures available to get rid of them if infested, would also be desirable in the case of large Strawberry grounds.*

* In this case I have not given a figure, for, though the greatly injured state of the Strawberry leafage would have been of very useful interest for illustration of the attack, the notes and specimens came to hand when I was suffering so severely from illness that it was with difficulty I could attend even to the daily requirements of correspondents.

Those who have the opportunity of referring to the figure of leafage injured by the allied insect, the *Galeruca* (or *Agelastica*) *alni*, given at p. 364 of the work of Dr. Ritzema Bos, before referred to, and at p. 291 of Part II. of the 'Practische Insekten Kunde' of Dr. E. L. Taschenberg, would find this showed the kind of injury to the Strawberry leafage very fairly, though not to the full and severe extent of that sent me.

TOMATO.

Root-knot Eelworm. *Anguillula radicola*; *Heterodera radicola*, Greef.; *Heterodera raditicola*, Müller.



HETERODERA RADICICOLA.

1, larva; 2 and 3, females; 4 and 5, eggs in different stages of development: all enormously magnified. (2 from sketch by Ed.; the other figures after Prof. Geo. Atkinson).

The *Heterodera radicola* is a small Eelworm which causes the growth of knots, or galls, on the roots of many kinds of plants, as those of the Tomato, Cucumber, Potato, Parsnip, Peach, Vine, Lettuce, and many others. These knobs are known as the root-knot disease, and according to the kind of plant, or the circumstances in which it grows, may be of the most various shapes and sizes, from a little knob perhaps not the twelfth of an inch across on Clover root, to large irregular masses of diseased growth, within which the "Root-knot" Eelworms are to be found, of both sexes, and in all stages, together with the eggs.

This infestation is to be found on the Continent of Europe, and in America, where it has been made the subject of careful investigation; but it was not until December in last year (1892) that observations of its presence in this country were sent me. In this case it was doing serious mischief by its gall formations on the roots of Tomatoes and Cucumbers; and though these cannot be classed amongst "Farm crops,"—and also it is to be hoped that our climate will not suit the Eelworm as a field infestation,—still it has manifestly a power of causing so much loss to growers on a large scale under glass, that the attack appears to need bringing forward.

In the present case I do not give the name, or the locality, of the

grounds of my applicant, for the obvious reason that it might be injurious to him in a business point of view, but I may mention him as a grower on such an exceedingly large scale, that the presence of such an infestation is a very serious matter.

The first communication was sent me on the 12th of December, and was as follows:—"I am a nurseryman, and grow a great quantity of Cucumbers and Tomatoes under glass. My houses are, and have been for the past three years, infested with Eelworms, which makes it difficult to get more than three parts of a crop." The writer added details of the treatment, as change of soil, &c., which had been carried out, but which had failed in clearing out the pest, and desired further information.

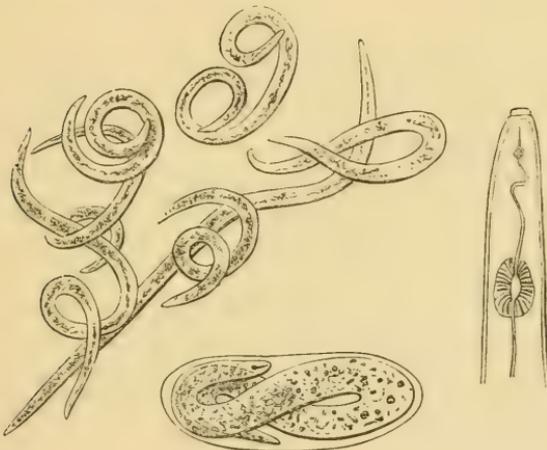
On my request for specimens for examination, my correspondent forwarded me, on the 19th of December, a most ample supply, being the lower part of the stem of six good sized Tomato plants with the roots attached. These roots were absolutely loaded with galls, as shown in the figure photographed from a few of them separated from the stem, and tied together for convenience of representation. Information was sent accompanying that the infesting Eelworms had been identified by Mr. Marshall Ward, Prof. of Botany at the Royal Indian Engineering College, as being *Heterodera radiculicola*, and from my own microscopic examination also of the contents of the galls, I found this to be the case. In the specimens sent I found the peculiar pear- or gourd-shaped females, as well as the ordinary Eelworm-shaped or thread-like males, and young wormlets, and also vast numbers of eggs.

As, however, in a newly observed infestation of this importance, it was desirable to have every possible information, I forwarded a packet of the infested galls to Dr. J. Ritzema Bos, of the State Agricultural College, Wageningen, as being most especially versed in the characteristics and history of the *Nematodes*, and requested his opinion. Without delay Dr. Ritzema Bos favoured me with the information that he found in the galls a very great number of the pear-shaped females, of which he added sketches (corresponding in form with those at p. 127), also *Tylenchus*-like males, and larvæ, and also noted, "There is no doubt at all that they belong to the species *Heterodera radiculicola*"; and in some further information relative to the nature of this infestation, which he was good enough to send me a few days later, he mentioned that he found "an immense number of females, males, larvæ, and eggs," and again noted that indeed it was doubtless the *Heterodera radiculicola*.

The following notes of some of the main characteristics in appearance of the Root-knot Eelworms are taken from the pamphlet on this subject, prepared from personal investigation by Prof. Geo. F. Atkinson, Prof. of

Biology at the Agricultural Experiment Station, Auburn, Alabama. This work contains the most fully recorded and carefully detailed microscopic observations of the Heterodera radiculicola with which I am acquainted, accompanied by a series of plates giving highly magnified representations of structure.—ED.*

The male is eel-shaped, slender, and exceedingly minute, being only about one twenty-fifth of an inch, or sometimes a little more, in length, and only seventeen thousandths of an inch in diameter at the middle; slightly less at the end of the tail; and in the anterior half the wormlet tapers from the middle to about half the central diameter at the head end. At this extremity is the *oesophagus*, or gullet, which is furnished at the foremost end with a minute needle-like point, capable of being thrust out and withdrawn, and technically



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.

known as the "exsertile spear." This spear, which rests on a trilobed base, is so very similar to that of the *Tylenchus devastatrix*, the "Stem Eelworm," which causes Tulip-root in Oat plants, and which has often been referred to in these Reports, that the accompanying figure of this *Tylenchus* will give a very good general idea of the form of the males and of the young larvæ of the "Root-knot" Eelworm, the *H. radiculicola*, and also of the position of the spear at the head end.

* 'A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radiculicola* (Greef.), Mull., and the Injuries caused by it upon the roots of various plants,' by Geo. F. Atkinson.—Science Contributions from the Agricultural Experiment Station, Alabama, U. S. A., Dec., 1889.

The eggs of the Root-knot Eelworm (the *H. radicola*) when mature are about three to four thousandth of an inch in length, and from their transparency the changes in appearance accompanying the growth of the contained wormlet may be observed within. Two forms of these are given in figures at p. 127, copied (and here acknowledged with thanks to the skilled observer) from Prof. Geo. F. Atkinson's plates.

The young root-knot wormlet (the larva, technically) is stated, when it comes out of the egg, to be from twelve to sixteen thousandth part of an inch in length, and (like the adult male) thread-like in shape, and like it has an "exsertile spear" with a trilobed base. These larvæ, having wandered about for a time, come to rest in the plant tissues, and undergo a change. The body of the wormlet is stated to enlarge, excepting at the two ends, and become rigid, so as to form a kind of chamber, or "cyst," in which the final change of the wormlet takes place to the perfect condition of male or female as the case may be. In fact this condition may be compared (in the case of the male) to the chrysalis state of some insects in which the maggot skin hardens, and the moth or fly forms within.

But in the case of the Root-knot Eelworm a very remarkable form of transformation takes place. In due time the male (after continuing to lengthen, and become more slender and thread-like until it is curled round several times within the "cyst" formed of its larval skin) completes its moult, and breaks forth from the cyst, and roams in the tissues until it finds its mate, when it pairs and dies. But in the case of the female the transformations accompanying development are very different. The male, as noticed, moults and comes forth from the "cyst," or old skin in which it has advanced to maturity; but (still abridging from Prof. Atkinson's observations) it is noted:—"The female does not moult again, but continues to enlarge enormously until it is gourd-shaped" (see figures at p. 127). "About the time the 'cysts' have reached the stage when the male begins its transformations, it is easy to distinguish the female cyst. This continues to enlarge or 'swell' until the tail part is cast and thrust aside, and the body is sometimes so much swelled at the posterior end as to cause a noticeable depression at the opening of the vulva.

"Fertilization is stated to take place long before this gourd- or pear-shaped cyst has ceased enlarging, this (that is, the female) continues to distend until in age its body is filled with eggs and young larvæ." And, "As the embryos are developing, the body of the cyst breaks up into an amorphic gelatinous mass, in which the young larvæ and eggs are found floating within the cyst cavity. Length of life cycle, one month."—(G. F. A.)

From the above notes it will be seen that amongst the main



West, Newman photo.

TOMATO-ROOTS.

Galled by attack of *HETERODERA RADICOLA*,
about two-thirds natural size.

[All rights reserved.]

characteristics of this "Root-knot" Eelworm that are moderately easily observable, are the differences in shape of the male and female. The female it should be carefully borne in mind is pear-shaped, or gourd-shaped, that is, short, small at the neck, and much swelled towards the base; the base itself being either flat below, or with a central depression. The males and young larvæ are thread-like (or, speaking more technically, *Tylenchus*-like) in general shape. These points are very important practically. For want of due observation of these characteristics, the attacks are apt to be wrongly identified, and consequently serious mistakes to arise in treatment.

Appearance of the galled roots.—The roots sent me were excellent examples of extent of infestation. These specimens were from good sized plants of Tomato, as the stems averaged quite an inch and a half or more in circumference a little above ground level, with a good mass of roots, averaging when held up as sent free from earth, about four or five to six inches in length, with some longer still, and about five inches in breadth. A great number of the root fibres were scattered more or less thickly throughout their whole length with the root-knot galls, even to the extremity, at a distance of six or eight inches from the collar of the plant.

Taking a mass of roots on one Tomato plant for special examination as a specimen of amount of gall presence, I found about twenty of the main roots were galled. These main roots as they branched and branched again, and even on the small side fibres, were infested with multitudes of irregularly shaped gall growths. Size as well as shape was quite irregular. Sometimes the "knots" were mere roundish fleshy lumps, about a quarter of an inch in diameter, but for the most part they ran wider, sometimes to half an inch or more in diameter, and very often ran to much greater length (see Plate), consequent on the galls having joined, and thus forming a confluent mass along the root fibre. These formed diseased swollen growths of from one inch to two or three and a half inches along the root fibres, but rarely averaged more than half an inch, or a little more, in diameter. The form was so wholly irregular that it can hardly be described, but is conveyed in the photograph.

When I first received the galled roots (sent me on the 19th of December), which had then been lying on a rubbish heap for about a month, the galls appeared to be firm and healthy, but soon many of them altered, in fact, fell to pieces, the bark peeling off, sometimes, according to circumstance, by drying, sometimes by wet decay, leaving (as noted at p. 132) merely the remains of the cells of which the gall had been composed, the harder parts of the tissue of the cells forming a little rough mass, a sort of miniature "rose comb-like" lump on the root from which the outer coat had peeled away.

The enormous amount of Eelworm presence in the galls was enough to spread infestation in the earth, and to all plants near capable of receiving it; but before giving further detail of this, and of the attempted measures for checking it, the following information, taken from the careful observations by J. C. Neal* on the commencement of the attack by the "invasion" of the wormlets from the earth, and its effect, deserves careful study.

Method of spread of infestation.—This may be in various ways. The Eelworm, when it comes into active life, may find its way through a crack out of the gall, or it may make its way into the surrounding tissues; or (it is stated) it can use its head end, aided by the spear, to pierce a way, firstly, *out* of the part of the gall in which it has developed; and, secondly, *into* the part of the root where it purposes to establish itself.

These operations I have not yet had the opportunity of observing in our British specimens, but one method of spread of infestation on a large scale was shown by the vast quantity of galls sent to me in December last. In these the contents of the infested gall were set free by the peeling off of the outer coat or bark of the so-called Root-knot.

Reference to the Plate will show the different conditions of the galls. Many of these were still perfect, but some, and notably one (fourth from the outside of the lower part of the figure, right-hand side of the Plate) will be seen to show the edges of the harder and more durable parts of the altered cells, of which the gall is composed, now free from the protecting bark. As in the galls which I opened, of the large numbers of which the bunch figured are samples, I found quantities of the infestation, with the Eelworm-shaped part of it showing its live condition by its power of movement, it is presumable that the eggs, and the egg-laden females (although from their shape their live condition was not similarly noticeable), yet were also alive, and well capable of continuing infestation.

In regard to the very important point of attack to rootlets taking place from "Root-knot" Eelworms wandering free in the soil, it is thus recorded from his own observations, by Dr. Neal.† "I have found mature worms, males and non-pregnant females, in rootlets but a few days old, and under circumstances which involved the necessity of invasion from without the root."

These *Anquillulæ*, Dr. Neal notes, were small enough to enter the stomata of epidermal tissues, and he thinks it "not unreasonable to

* See 'The Root-knot Disease of the Peach, Orange, and other plants, in Florida,' by J. C. Neal, Ph.D., M.D. Washington: Government Printing Office, 1889.

† See Report by Dr. Neal, previously referred to, p. 12.

infer that, in this manner, they obtain entrance in young rootlets." Once within they can make their way about in the tissues of the root, and the result of their presence is the unnatural development of cells, producing the irregular growth known as the gall or root-knot.

The variety both in form and locality of the galls on the roots, and in effect of the infestation to different kinds or classes of plants, especially to field vegetables, and to fruit trees, are clearly and serviceably detailed by Dr. Neal. Of these I quote the following paragraph as most applicable to our own circumstances:—"The roots of the Okra, Radish, Turnip, Cabbage, Cucumber, Melon, Cow-Pea, Peanut, Tomato, and Egg-plant enlarge enormously, soon becoming little else than masses of decaying tissues. The plant stops growth, the fruit either becomes distorted, or drops prematurely, the leaves change colour and fall off, and the plants die so rapidly as to justify the usual expression 'struck by lightning,' applied to the fields of Melons, Cucumbers, Tomatoes, and Cow-Peas, so often badly affected by the root-knot" (J. C. N.). This rapid and sweeping effect, it should be observed, is an account of damage in U. S. A.; circumstances, where climate permits Melons and Tomatoes to be grown in the open air in fields, put this Eelworm attack on a very different footing to what it is here. In some other attacks the enlargements caused by the root-knot are chiefly on the main stem, near the surface of the ground; in others, as in nurseries of young Peach, Orange, or English Walnut sown for stocks, when the trees have failed from infestation, the cause is found "in the knotty decaying roots, without rootlets, or fibrillæ"; and as observed by Dr. Neal in a few words of summary of this part of his report:—"In all of these cases the effect is to deprive the stems and leaves of the food and moisture; the knots grow, the branches do not."—(J. C. N.)

The kinds of soil favourable for growth of Root-knot, appear to be those which unite lightness and dampness. Thus the wormlets can travel with the most convenience to themselves when on their way through the earth to a new settlement, and they have also the moisture which is favourable to their vigorous growth. It is stated that "localities highly fertilized with composts, stable manure, or leaf-mould, show the root-knot quicker in plants, than in compact or virgin soils, and the worst results are found in gardens planted in long cultivated, fully fertilized, and thoroughly pulverized areas." . . . "A dry soil with solid growth is"—"unfavourable, hence, in many locations, drainage has entirely changed the character of the land, so that Peaches and Figs grow where they would not before."

Infestation spreads rapidly from galled roots. Amongst various instances showing this is a case where, "In a spot of new and non-infested ground, several trees, Peach and Fig, were planted. The

central tree was 'knotty-rooted,' and died in a few months; next year the roots of the nearest trees, 15 feet away, became knotty nearest the dead tree, and in four years the disease extended to the tips of the roots of all the Fig and Peach trees in a circle 120 feet distant each way from the original infested tree."—(J. C. N.)

The point of even temporary presence of infested plants starting presence of the pest is illustrated by a case where, in a nursery free from disease, some Peach trees with "knotted" roots brought from a distance were "heeled" in for a week, the disease spread in all directions from this nucleus.

From his various records of observation Dr. Neal gives the summary that the disease can be easily introduced into areas not infested, "(1), by planting infested trees; (2), by the use of composts of muck and weeds from infested soils; (3), by the distributive action of water and air, the water carrying particles of soil and worms downward from an infested elevation, or by dry soil, fragments of dry roots"; . . . and he also notes, "(4) soil containing these worms, I have no doubt, has been carried on the feet of men and animals, and deposited in healthy fields, forming the nucleus of a destructive agency, months afterwards made visible by its effects."—(J. C. N.)

To the above notes, taken from Dr. Neal's very useful observations, should probably be added, in regard to the last item as to methods of transportation,—carriage in soil adhering to agricultural or garden implements, as ploughs, spades, forks, or trowels, or on wheels of carts or wheelbarrows. Also (most especially) care should be given in infested nurseries, or rather (in our country) in hothouses, or in growing of crops, such as Cucumbers, Melons, or Tomatoes under glass, that all earth in pots, or boxes, where infested plants have grown should be *burnt*, and the pots, or boxes, well scalded. If the earth, or the galled roots, are merely thrown to the rubbish heap, there is no limit to the mischief that may be done; even by the carriage of the wormlets about the place on the feet or feathers of birds, cats, dogs, or other creatures.

In the excessively bad attack (in which the losses may be reckoned by tons), of which the appearance here is the reason for drawing attention forcibly to what might be a most severe trouble, we do not yet *know* with certainty from whence it came, but evidence points towards it having been imported several years ago from Germany. This *H. radiciola* is a European as well as an American pest, and amongst plants infested by it is *Dracana rosea*. In our case *Dracanas* were noticed as unaccountably failing, so much so that the cultivation of them was given up, and this trouble was followed (about four years ago) by attack on the Cucumbers and Tomatoes, gradually increasing

until it has reached the destructive point which has brought it under consideration.

We do not as yet know of this Eelworm as a field crop pest here, but to growers under glass, the extreme difficulty of getting rid of the infestation, when once established, makes the presence of such a pest serious in the extreme.

In the paper on this Nematode by Dr. J. Ritzema Bos,* he mentions that "The ground in which the Root Eelworms have once been found, commonly remains infested agriculturally, and will only produce diseased plants," and in the case on which I am writing the expense of removal of infested soil, and carting in what it was hoped would remain clean, and also applications which it was hoped might poison the pest, have met with very far from the success which could be desired.—ED.

Amongst the details of experiment made under the direction of the Entomologist of the United States Agricultural Department, and recorded by Dr. Neal, I do not find that any of the applications were thoroughly remedial. It is stated, however, that alkaline mixtures, 20 to 40 lbs. to each tree, or caustic lime, kainite, muriate and sulphate of potash, or wood ashes, used several years in succession, have come nearest a cure, destroying no doubt many free worms, and inducing a vigorous tough growth of roots more difficult of penetration. It is especially mentioned that a liberal application of the fertilizer is requisite, "Not less than 3000 pounds to the acre should be used to produce the required effect, one-half in December, the remainder in May" (J. C. N.). This of course must be taken with consideration of nature of fertilizers, also of cost.

A method which appears really to act serviceably (where circumstances allow of its adoption) is the use of "trap plants." In field cultivation, as, for instance, in Continental infestation, where the Eelworm may be at Clover roots, it may very likely not answer thoroughly, because (as pointed out by Dr. Ritzema Bos), this kind of Eelworm infests such a variety of kinds of plants, that the "trap" or "catch" plants may not be a special attraction. But in growing under glass the plan might be thoroughly utilized.

The points to attend to, are to choose some plant which the Eelworms are known to be partial to, and when this has grown, to keep careful watch by examination of some of the plants as to how the plan is working. Firstly, whether the galls are forming; and, secondly, their condition, so that the "trap plant" crop may be cleared out, and destroyed before the wormlets are sufficiently mature to make their way out from the galls, and thus simply add to wormlet presence

* 'Tierische Schädlinge und Nützlinge,' von Dr. J. Ritzema Bos, p. 781.

instead of lessening. In examination of the plants, and also in clearing them, it should be most carefully seen to that they are *not raised by being drawn out of the soil*. They should be raised so that the earth comes with them, otherwise the little knobs on the root are just as likely as not, from the obstruction they cause in drawing, to cause the young rootlets to break off, and thus the examiner be unaware of the presence of galls. And in clearing the "trap plant," neglect of this precaution would leave the ground full of infested "knots." A glance over the list of common plants subject to infestation would suggest what might be serviceable; very possibly Radishes might be of use, but one plant particularly recommended for the purpose is Lettuce, sometimes known as "Salad."

In my recent correspondence with Dr. Ritzema Bos on this subject, he favoured me with the following remark, embodying the opinion of the well-known observer of these Eelworms, Herr Frank, on this subject:—"Frank says that *Lactuca sativa* (the common Lettuce) can be used with success as a trap plant; but as the larvæ leave the galls principally in the winter and the spring, the *Lactuca* should be sown as early as possible in the spring or the winter."—(J. R. B., Dec. 31st, 1892).

As yet we do not know to what extent the *Heterodera radicola* is present here, but with the knowledge of the characteristics of the attack, it is very likely more information may be received on this head, as being a trouble to growers of garden crops under glass, as Cucumbers, Tomatoes, &c. Whether the pest is present in out-of-door crops here, we are (as far as I am aware) without any reliable proof at present.

In 1886, a paper was published in the 'Gardeners' Chronicle' (p. 172, vol. xxvi.), in which a very good account was given of the characteristics of the Oat-plant attack, which has since been most minutely observed, and which is well known under the name of Tulip-root, or Segging. In this the writer guardedly suggests that this disease is caused by the *H. radicola*; he does not say that it is so, but merely, "I take the worm to be *Heterodera radicola*"; and after carefully studying a copy made for me of the paper, and of the figures of the Eelworms accompanying (the original being out of print), I do not find any mention of the pear- or gourd-shaped females which are an essential condition of the *Heterodera radicola* now under consideration. The long thread-like forms of all the Eelworms figured quite correspond with those of the *Tylenchus devastatrix*, which has now been shown by successive years of investigation to be the cause of Tulip-root.*

* See also note, p. 6, of 'L'Anguillule de la Tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos; 'Annotations Deuxième Serie,' Haarlem, 1891, in which the above points are entered on at length.

Although there are some points of great similarity between Eelworms of the genus *Heterodera* and *Tylenchus*, they are clearly distinguishable with the help of good microscopic powers, if the females are present, for whilst both males and females, and also the larvæ of the *Tylenchus devastatrix*, are thread-like, or like long and narrow eels in miniature; in the case of the *Heterodera radicola* it is only the males and the larvæ in their early stage which have this thread-like or eel-like form; the females are of the peculiar form, like a gourd, swelled at the lower part, and contracted at the top, which is figured at p. 127.

This is a matter of considerable practical importance, for the treatment of the two kinds of Eelworms by no means rests on the same basis. The *Tylenchus* may be destroyed, and the plants brought over attack, by cheap and easily applied chemical dressings, which so far as we see at present are useless for extirpation of *Heterodera radicola*.

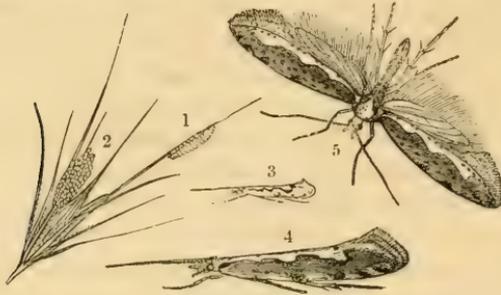
Careful experiments, on what is, unfortunately, necessarily a large scale, are now in progress, of which any satisfactory results will be recorded.*

* For those who wish to study the subject at length, I may mention that of the papers which I have quoted from, that by Prof. Geo. F. Atkinson deals at minute length, and very serviceably for scientific observers, with the structural characteristics and life-history of the Nematodes. It also gives many excellent and enormously magnified figures of them in both sexes and various stages, with anatomical detail; and, in addition to collateral considerations, most copious references are given to publications on this and other allied Nematode attacks, and somewhat analogous gall formations, by many European, and also some American writers.

The paper by Dr. Neal deals chiefly with the subject practically, from the horticultural point of view, as the "Root-knot Disease" of Florida, by an *Anguillula*, which, in the absence of the literature of the subject, was named by the writer the *Anguillula arenaria*. This paper also has many plates, including some very useful coloured figures of galls.

TURNIP.

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



PLUTELLA CRUCIFERARUM.

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

The first reports of appearance of Diamond-back Moth infestation were much earlier in 1892 than in the notable attack of the preceding year. Then, so far as appears, no notices were received pointing to the coming trouble until when early in July the caterpillars were reported as doing much harm at a locality on the Yorkshire coast, and later (on the 17th and 20th of the same month) the first observations of severe injury on the Scottish coast heralded the long train of notices of serious mischief. Subsequent enquiry showed the moths to have been observed, and duly identified, some weeks earlier, the first record given being on the 24th of June.

In the year now past (1892), the infestation was recognised on its first appearance in moth state, so that we were prepared for what was coming. Mr. Edw. A. Atmore, F.E.S., writing from King's Lynn, Norfolk, informed me:—"This year I first noticed *Plutella cruciferarum*, the Diamond-back Moth, in the neighbourhood of Lynn, on the 17th of May, and from that time their numbers seemed to be on the increase; so much so that on the 29th of May when at Westwick, near this town, they seemed to be everywhere."

On the 28th of May, Diamond-backs were sent me as samples of the species of moths then flying in large numbers over fields near Pocklington, in Yorkshire; and on the 31st of the same month, Mr. Andrew Balsillie, who had paid careful attention to this attack in 1891, reported the recent appearance of the moths in considerable numbers on St. Andrew's Links, and also that it was present on the neighbouring fields. On the same day reports were also sent me of the appearance of the Diamond-back Moths in considerable numbers near Crail, also in Fife, and also near Errol, Co. Perth, N.B.

Other communications rapidly followed, including notes sent on the 2nd of June of appearance of the moths at the much more northerly locality of Orbliston, Fochabers, Co. Moray, and various other localities, as Acklington, Northumberland, and a note from Mr. J. E. Reeve, of North Walsham, Norfolk, who, as well as Mr. Atmore (p. 138), reported the remarkable amount of Diamond-back Moths. He observed in a communication bearing date June 2nd:—"The Diamond-back Moth has made its reappearance on the north-east coast of Norfolk in clouds, and swarming particularly where there happen to be Cabbage plants." On the following day presence of the moth was reported (specimens also accompanying) as occurring on Cress, near Kelvedon, Essex.

Notes of observation of the moths were sent from various localities till the middle of June, and to some degree the first brood was observable later, some stragglers being still reported, together with advanced caterpillar mischief.

On the 20th of June the first reports of caterpillar presence began, and after some slight notice of the larvæ being spinning up, an observation was sent me on the 5th of July, from Kelvedon, Essex, with completely characteristic specimens of Diamond-back cocoons containing the chrysalids, and the information that in some places there the caterpillars of the Diamond-back Moths had quite destroyed the crop, and thus, in this we have secured some amount of record of rate of advance of the infestation, through its different stages.

The first notes of appearance of the Diamond-back caterpillar, and also of it being spinning up to go into chrysalis state, were sent me respectively on the 20th and 30th of June, by Mr. D. D. Gibb, from Ossemsley Manor Farm, Lymington, Hants. On the 20th Mr. Gibb wrote me as follows, enclosing specimens:—"About ten days ago, in crossing a field of Oats, following Turnips and Swedes which I believed to have suffered from Diamond-back Moth last year, I found moths flying in thousands, and some of these, so far as I could see in the dusk, very closely resembling the Diamond-back Moths." (The specimens of moths sent me by Mr. Gibb were quite certainly of this species.—ED.) "I did not find time to again visit this field until to-day, when I found small caterpillars resembling those of Diamond-back Moth in great numbers on leaves of Charlock plants growing among the Oats."

On the 30th of June, Mr. Gibb forwarded various caterpillars for examination, of which those he distinguished in his notes as "the small caterpillars" proved to be of the Diamond-back Moth, and one of them was then spinning its cocoon. Of these it was observed that they "entirely swarm on young Cabbage, &c., plants."—(D. D. G.)

The next date of appearance of caterpillars reported was on the

22nd of June, sent me from Boughton Grange, Northampton, by Mr. Wm. Jermyns Brooks, with the following observation:—"I enclose you some leaves of Kohl Rabi with small caterpillars on, which are injuring the crop a good deal."

On the 28th of June, specimens of Rape leaves so much eaten as to show that the attack was thoroughly commenced in this locality, also were sent me by Mr. James B. Harding, from Wolf Hall Farm, Marlborough, Wilts. Mr. Harding wrote:—"I am instructed by Lord F. Bruce to forward you specimens of insects found eating Rape on his farm." . . . "The moth I found on the leaves with them, and thought it better to send it, as I found two or three more."

"The insects attack the plant on the under side of the leaves, and leave them like the two enclosed; the field, where attacked, presents quite a white appearance."—(J. B. H.)

The specimens of leaves sent were so eaten away that they were in the condition like lace-work, often noticed in severe amount of this attack, and it will be observed that in coincidence with the caterpillar attack being so fully established, that there were now only stragglers noticeably remaining of the moths.

The following observations, with which I was favoured by Mr. J. P. Stuart, of Orbliston, Fochabers, Co. Moray, N.B., respectively on the 10th of June and the 20th of July, as taken in connection with the note of moth appearance at Fochabers (see p. 139), put in our hands a valuable record of observation in this northerly part of Scotland of the duration of the moth presence; the date of their complete disappearance, and then the date of (what was only too surely to be expected) the appearance of the caterpillars from the eggs which had been laid by the moths before they perished.

The following letter was sent me on the 10th of June:—"Since writing you a few days ago, I have been observing the progress of the Diamond-backs; but strange to say they seem to have almost disappeared for the present. I yesterday, when examining my Swedes, could only find a few moths where they were in large numbers only a few days before. The conditions of the weather were great heat and scorching sun, and no wind. I commenced to top-dress to-day, to prevent a return of the pest."

The next report with which I was favoured by Mr. Stuart was on the 20th of July, when he mentioned first appearance of the Diamond-back caterpillars having been observed early in the preceding week, or probably "in the first week of July," amongst his Swedes, which thus gives the date of attack just at the time of first reports of it in the preceding year (1891), namely, the beginning of July, and the 17th of the same month. Mr. Stuart wrote as follows:—

"In continuation of our correspondence of last month on the sub-

ject of Diamond-backs, I have now to inform you that the caterpillar was observed early last week, or probably, say, the first week of July, amongst my Swedes. So far the weather has not been favourable for their development, and I myself could find very few. They were there, but nothing can be done at the moment on account of heavy cold rain, which will probably save a lot of trouble in getting rid of them."—(J. P. S.)

The reports sent in during July were not numerous, but showed caterpillar ravage to be going on at various places widely apart, and in some cases to be serious. Also they showed the irregular progress of the stages of the attack, as though in some localities the caterpillars were spinning up to pass into the chrysalis condition early in the month; in others, even in localities as widely separated geographically as Kintore, in Aberdeenshire, N.B., and Swindon, Wiltshire, the caterpillars were still at work, respectively, on the 28th and 29th of the month.

On the 4th of July the following notes were sent to me from High Blaithe, Wigton, Carlisle, together with samples of the attack:—
 "I beg to enclose for your information specimens of the caterpillar of the Diamond-back Moth, which I find infesting my Turnips. I also enclose one plant to show the average size of the Turnips so infested. I observed the moths in large numbers frequenting the edges of the Turnip fields about a month ago, and I suppose these are from the eggs then deposited. I do not think the caterpillar exists in such numbers as to destroy the crop, but I suppose these will soon go into cocoon, from which will emerge moths, which will breed a sufficient number of a later brood which will be quite in time, under favourable circumstances, to cause serious loss to the crop."

On the 6th of July cocoons were sent me from Billingham, Lincoln, by Mr. Frank Gilbert, with the note, "When looking over our Mustard this morning we found a large number of cocoons on the plants."

On the 11th of July, Mr. J. W. Moss, of Kelvedon, Essex (who had communicated on the 5th regarding cocoons of the Diamond-backs, of which the caterpillars had been doing much damage on two kinds of Cress), wrote me further, "That the infestation was increasing enormously, and totally destroying some portions of different crops,—Cress, Cabbage, Broccoli, &c.; and about an acre of Crimson Candy-tuft (flower seed) is suffering terribly, and may perhaps be worthless."

Amongst various specimens sent me from Kintore, Aberdeenshire, on July 28th, as being then found on Turnip plants in the district, the Diamond-back caterpillar was present; and on July 29th, a packet of large Swede leaves badly eaten by caterpillars of the Diamond-back Moth (the caterpillars being very numerous on them) were sent me

from Lambourn, near Swindon, Wilts, as samples of an infestation which had not been observed before in the neighbourhood.

After this date no further reports of this infestation were sent me, which gives the time over which presence of Diamond-backs in some one or other of their different stages extended in 1892, as being from the 17th of May to the 29th of July, and, so far as can be judged by reports sent to myself, the attack was far less prevalent than in 1891. The localities from which it was reported were very much fewer, the attacks mostly were much less severe, and whilst in 1891 the damage continued to be a serious matter during much of July, and even in some cases up to the middle of August, it is satisfactory to note that in 1892 I had no reports of serious mischief after the 11th of July.

The methods of prevention and remedy require no further comment, as these were entered on fully in my preceding report, and in the past season it has again been noticed that any treatment to keep up the strength of the crop under attack is especially desirable.

The Diamond-back Moths are only about two-thirds of an inch across in the spread of the fore wings, and as usually seen in a somewhat rubbed condition look like brownish grey moths, paler or darker according to the amount to which the powdery plumage forming the pattern on the wings has been rubbed away. When in perfect order they are easily recognisable by the diamond-shaped pattern formed as figured at p. 138 by the light marking down the edges of the fore wings as they lie together when at rest. The caterpillars are usually of a delicate green; sometimes in young state yellowish or greyish, with black head. When near full growth the head is usually grey or yellowish, and the next ring is *without* the two black patches often found in caterpillars of this nature. The segments have some black dots, and the caterpillar tapers slightly towards each end, and at full growth is about half an inch long.

When full fed the caterpillars spin cocoons in any convenient spot on or near their food plants. These may be a mere open net-work of threads, or thicker, and of a sort of boat-shape, and within these the caterpillar changes to a chrysalis, which, when mature, is (characteristically) whitish, with some black streaks. In their early stage they may be grey or brownish.

The above note is only given as a general guide to the appearance of the infestation, the details of this and other points of the attack having been so very fully entered on in my 'Report of Observations of Injurious Insects for 1891,' pp. 105 to 164.



West; Newman photo.

C A B B A G E - R O O T

affected by disease known as
FINGER-and-TOE ; CLUB ; or ANBURY ; caused by
SLIME FUNGUS (*Plasmodiophora brassicæ*).

TURNIP AND CABBAGE-ROOT ATTACKS.

Turnip and Cabbage Root-gall Weevil. *Ceutorhynchus sulcicollis*, Gyll. **Turnip and Cabbage-root Flies.** *Anthomyia radicum*, Linn.; *A. brassicæ*, Bouché; *A. floralis*, Fallen, &c. Also the disease caused by **Slime Fungus**, *Plasmodiophora brassicæ*, Woronin, commonly known as **Finger-and-Toe, Anbury, or Club.**

Amongst the yearly enquiries sent regarding damage supposed to be caused by various kinds of insects to Turnips and to Cabbage-roots, a large proportion of the attacks referred to prove, on examination of specimens sent, to be due, not to insect infestation, but to the diseased growths commonly known as "Anbury," or "Fingers-and-Toes," when they occur in Turnips, or as Club when it is the roots of Cabbages that are affected, which is caused by a "Slime Fungus."

Various kinds of insect infestations may very possibly be present, but as there is often difficulty in distinguishing the mischief caused by these from the mischief shown in the diseased growth caused by the Slime Fungus, it may be of some service to give the accompanying figures taken from life of "Finger-and-Toe," and allied forms of these distorted growths, which, by comparison with the figures of insect attack and descriptions, will show the differences in the nature of the attacks.

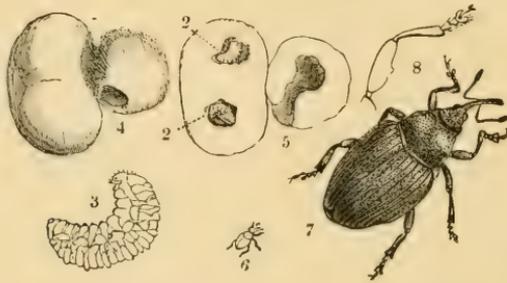
The few paragraphs immediately following are given as a short preliminary notice of the main points of observation.

Of the two most injurious kinds of insect infestation to the roots which are commonly met with, one is that of the maggots of Cabbage and Turnip-root Flies, which bore into the roots and cause mischief, sometimes to a very serious extent, by the decay thus originated, as well as by their destructive gnawings; but they do *not* cause gall growths, nor do they cause the diseased, enlarged growths which we see in cases of "Finger-and-Toe," or "Club."

Another common insect attack is that of the Turnip and Cabbage Root-gall Weevil. This causes the smooth roundish knobs, or groups of knobs, that are very often to be found on Turnips and Swedes, and also on Cabbage-roots; these lumps, or galls, being from about the size of half a pea to that of half a hazel nut, and when somewhat advanced in growth they have usually a hollow central chamber in which lies a legless, wrinkled maggot, with a chestnut-coloured head. But this attack (as well as that of the root fly maggots) does not cause malformations of whole roots.

Other kinds of insect attacks may also be present, as, for instance,

of the Turnip Winter Gnat, also of the Rove Beetles, popularly known as "Devil's Coach Horses," and there may very likely be presence of *Acari*, or Mites, in great numbers. But none of these, nor yet the presence of any other insect, or Mite, or worm infestation of any kind whatsoever, causes the growth commonly known as Finger-and-Toe, Anbury, or Club. This is caused by a Fungus, a "Slime Fungus," the *Plasmodiophora brassicae*, scientifically, which infesting the roots, by passing into them from infested soil or surroundings, gives rise to the swelled and misshapen, and, in bad cases, ultimately putrid condition of the diseased roots, which causes yearly widespread loss in field and garden crops in many parts of the country.



CEUTORHYNCHUS SULCICOLLIS.

1—5, galls with maggots, nat. size and magnified; 6, 7, weevil, nat. size and magnified; 8, leg of weevil, magnified.

It is very possible—in all probability it may often be the case—that Turnip and Cabbage-roots infested by Gall Weevils, or by Root Fly-maggots, or other insect attacks, may also be Finger-and-Toed, or Clubbed, for there is nothing in the nature of the insect attack to act as a preservative against the fungoid infestation. Also it is exceedingly likely that Clubbed or Finger-and-Toed roots should be infested in addition by insect presence. I know these attacks to occur coincidentally from my own personal observations, and in the words of Messrs. Sutton, "When we cut open a large offensive Club, it is no unusual thing to find it packed full of strange creatures, like a travelling menagerie!"* But all the same, each several kind of attack gives rise only to its own special kind of mischief, of which the origin, the history, and the effects are clearly distinguishable the one from the others, and though Clubbed or Finger-and-Toed, roots may (as above mentioned) be often found with insect infestation present, I am also aware, from personal examination, that they may often be found without it. Taking now, firstly, and in sufficient detail to make them clearly recognisable, such of the insect infestations as are most

* 'Culture of Vegetables and Flowers from Seeds and Roots,' by Messrs. Sutton & Son, p. 285.

commonly confused with the malformations known as "Finger-and-Toe," &c.; that of the Turnip and Cabbage Root-gall Weevil, with the knobs and lumps that it causes on the roots, is perhaps the attack least easily distinguishable from the lumpy deformities caused by the Slime Fungus.

This attack is caused by a small blackish weevil beetle, of shape and size figured at p. 144, furnished with a long curved snout, to the sides of which are affixed a pair of "elbowed" horns or antennæ; the thorax, or fore body, has a channel running lengthwise along the centre, and the wing-cases have very fine furrows running along them. The beetles have a slight sprinkling of whitish or grey scales above, and beneath are light coloured from the greater amount of these scales.

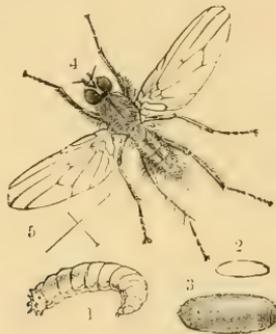
The female lays her eggs either on the surface of the attacked roots, or in a little hole which she forms for their reception, and the maggots which hatch from these establish themselves in the outer part of the Turnip bulb, and in the case of Cabbage plants for the most part in the main root, or rather underground stem. There the presence of these maggots causes the growth of the galls, within which they may soon be found, even without the help of a magnifying-glass. They are (when seen magnified) whitish grubs, very much wrinkled across, fat and fleshy, and with a yellowish or chestnut head, armed with strong, toothed jaws, these also chestnut-coloured, and darker at the tips. These maggots are legless, commonly lie curled on one side, as figured at p. 144, and I have noticed that they varied in colour with their food, being of an orange colour when feeding on Swedes. When full-fed they leave the galls, and make little earth cocoons in which they turn to chrysalids, and thence to weevil beetles. But the main point here is to give the distinctions by which the insect-galled roots may be known from those that are fungus-diseased. One point is the regularity of the formations, as shown in the figure. The galls are commonly rounded smooth knobs, single or in groups, as shown, and on cutting them open, we do *not* find, as in Finger-and-Toe, or Club, a mere mass of disorganised tissue progressing to general rottenness, but we find, as figured at p. 144, a central chamber bearing signs of having been



Young Rape plant with galls of *C. sulcicollis*, after Dr. Ritzema Bos.

gnawed out by the maggot lying in it. Or, in case we come to our examination after the maggot has made its way out, still we have the exit hole, the regularly eaten out cavity, and the dirt, or "frass" as it is called, consequent on the feeding of the maggot, to prove exactly what has been going on. There will very likely be decay also, for injured Turnip and Cabbage-roots soon decay; but this will be local at, or starting from, the rotting remains of the galls, and very easily distinguishable from the masses of mere shapeless rottenness produced by an old club.*

Another of the insect attacks often prevalent to a serious extent, and not always distinguishable from "Finger-and-Toe," is that of the Turnip and Cabbage-root Flies.



ANTHOMYIA RADICUM.

1, maggot of *A. brassicæ*; 2, 3, pupa-cases, nat. size and magnified; 4, 5, *A. radicum*, magnified, and lines showing nat. size.

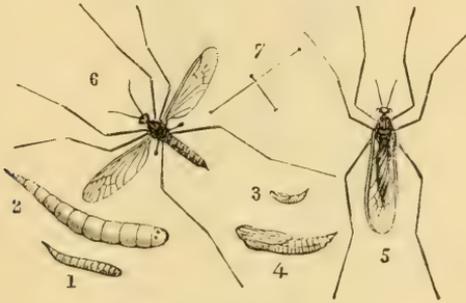
There are several kinds of these root flies, of which three species, scientifically known respectively as the *Anthomyia brassicæ*, *A. radicum*, and *A. floralis*, are so much alike in their various stages, and their method of life, that it is difficult to distinguish them without very minute examination. The figure of the kind more particularly known as the Root Fly, given at "4" above, conveys a good general idea of the appearance of these flies when much magnified. The length and extent of spread of the wings are given at "5." The general colouring is of black and grey, differently disposed in stripes, dots, &c., and there is a little difference in size. The maggots are also very similar in appearance, and are legless, cylindrical, and tapering to the head end, which contains the hooks that serve as a feeding apparatus, and they are blunt at the tail. When full-fed they turn (commonly in the earth) to chrysalis condition in cases of about the shape and size figured above of those of the Cabbage-root Fly; these are of some

* The methods of prevention are given further on, in order not to interrupt the description of the appearance of the infestation.

shade of brown, or reddish brown, or in the case of the *A. radicum*, sometimes of an ochreous tint.

It is generally considered that the *A. brassicae* and the *A. radicum* are the commonest kinds, but in 1883, when Cabbage-root attack was unusually prevalent, the kind known as *A. floralis* (sometimes as the Radish Fly) proved to be most present.*

Returning now to the points which cause confusion between this fly-maggot attack and Finger-and-Toes. The maggots eat passages in Cabbage and Turnip-roots, and possibly there may be no external swelling; but also there may be. The Cabbage-stalks may be swelled, and they usually become putrid, and Turnips also are subject to the same changes. In the larger proportion of enquiries sent to me in the past season regarding the fungoid disease described, as the case might be, as "Anbury," "Finger-and-Toe," or "Club," the senders connected



TRICHOcera HIEMALIS.

Winter Turnip Gnat, maggot and pupa, nat. size, and magnified.

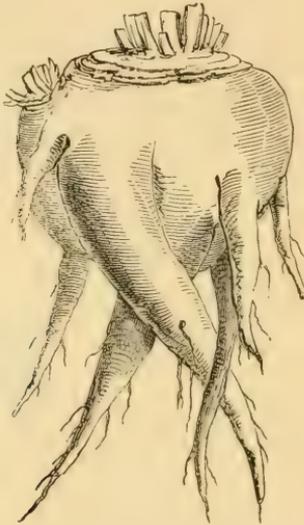
it with the presence of grubs or maggots, sometimes specified as "fly-maggots"; but still these maggots, though coincident with the disease, as I could see for myself, in no way caused it. The characteristics of the fungoid growth, as will be shown further on, are distinct and well marked, and (though insects are often present) these growths are often to be found *unaccompanied* by any insect galleries, or insect workings.

Another insect attack sometimes, like those above mentioned, incorrectly connected with Finger-and-Toe presence, is that of the Winter Turnip Gnat, the *Trichocera hiemalis*.

* Those who wish to go into the subject in detail will find observations on the Cabbage and root flies in Curtis's 'Farm Insects,' and on these and the Radish Fly in the 'Praktische Insekten-kunde' of Dr. Taschenberg, and in the 'Tierische Schadlinge und Nützlinge' of Dr. Ritzema Bos. References to this infestation are given in various of my own Annual Reports, and especially at pp. 10—17 of that for 1883, when I had the advantage of specimens being identified for me by Mr. R. H. Meade; and consequently became aware of the extent of the injuries of the "Radish Fly."

These little gnats may often be seen in swarms, or parties, of vast numbers hovering at some one spot during the winter, and their maggots feed especially in rotten Turnip bulbs.

Passing now from malformations caused by insect presence, and also from insect presence occurring in rotten Turnips or Cabbage, it is necessary to give a few words to the spindly and much divided growth (figure below) to which formerly the name of Finger-and-Toe was sometimes given.



This is in no way a diseased growth, rather the reverse. It is a movement backwards towards the original condition of the roots, whether of Turnip, or Carrot, or Parsnip, in their wild state, free from the fleshy developments brought about by high cultivation. In the words of John Wilson, Prof. of Agriculture in the University of Edinburgh, it is "well known to the vegetable pathologist as 'dactylorhiza'" (from two Greek words signifying, respectively, a finger or toe and a root.—ED.), "the intermediate condition between the natural (wild) and the artificial state." *

The experiments at Rothamsted (1843-45) showed that by planting on unmanured land several years in succession, at the fourth year the Turnip-bulb had disappeared, and the root resumed its former wild state. The experiments and observations of Prof. J. B. Buckman at the Royal Agricultural College, Cirencester, show that this split and spindly-rooted state may be induced by a variety of causes, as weakness of seed, poorness of ground, and other circumstances; and in the concluding lines of his elaborate paper on this subject, Prof. Buckman

* 'Our Farm Crops,' by Prof. Wilson, vol. i., p. 316.



West, Newman photo.

CABBAGE-ROOT

affected by disease known as
CLUB; FINGER-and-TOE; or ANBURY; caused by
SLIME FUNGUS (*Plasmodiophora brassicæ*).

notes of *this form* that he considers "The enumerated experiments seem to show that Finger-and-Toe is the midway from wildness to cultivation; and our observations upon the circumstances connected with cultivated root crops, that the malformation in them, is the result of degeneration from cultivation to wildness."—(J. B. B.) *

Finger-and-Toe being a name applicable to any much divided root growth, has unfortunately been applied to very different conditions; but, so far as I am aware, the other common names applied to the swollen tumour-like masses of the fungoid disease known also as Club and Anbury, have never been given to this state of "calling back" to the original form of root above noticed. Its spindly, or Radish-shaped, and regular and sound, though much divided development, is the very opposite of that of the swollen masses which now cause so much loss in the country, and I have only alluded to it because an occasional enquiry shows that confusion sometimes still exists, solely in consequence of one name having been applied to two or more distinct kinds of attacks, of all of which we now are well acquainted with the respective histories.

FINGER-AND-TOE, ANBURY, OR CLUB.

The diseased swellings and malformations of roots which are known in this country by the above names, and on the Continent as *Hernia*, or rupture, and which especially affect the roots of Turnips and Cabbage, are caused by infestation of a "Slime Fungus," scientifically the *Plasmiodiophora brassicæ* of Woronin.

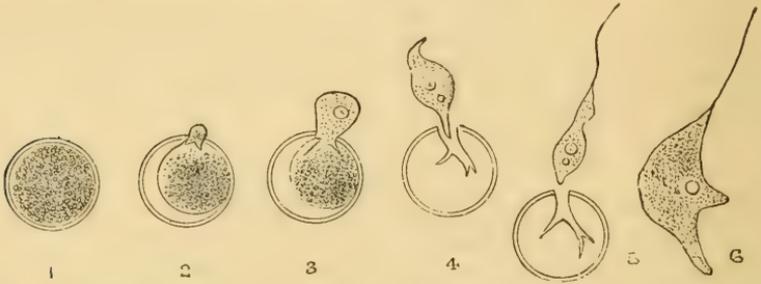
The accompanying Plates showing three characteristic forms of this diseased growth are from photographs of specimens kindly sent me at my request from Balderton Hall, Myddle, near Shrewsbury, by Mr. G. G. Blantern, and to save any confusion as to the nature of the attack, it has seemed best to give all three popular names on each Plate, with the name commonly applied to the form figured placed first. (See Frontispiece, and Plates to face pp. 148 and 149).

Now that the information has been placed in our hands, of the precise nature of the infestation, with full details of its history, it is easy for any qualified observer, with the help of a sufficiently powerful microscope, to trace out all the minutiae of this "Slime Fungus" attack, and its effects on the infested tissues for himself; but it was not until the year 1876, when, after long research, the precise nature of the attack was discovered by M. Woronin, a Russian botanist, that its true history was known. For many years I have myself been obliged, in the course of my regular work, to study it practically, and to some

* 'Finger-and-Toe in Root Crops,' by James B. Buckman, F.G.S., F.L.S., Prof. of Geology and Botany, Royal Agricultural College, Cirencester, published in Journal of Royal Agricultural Society of England, vol. xv., 1st series.

extent microscopically; but not being a regular fungologist, I give the following abstract of the main points of life-history of this Slime Fungus from the digests of Prof. Marshall Ward and Mr. Worthington G. Smith.*

It appears that if a section of a diseased root is examined microscopically, a portion of the greatly enlarged cells will be found filled with what may be called spores, or spherules, or (generally) a formation from which a young "Slime Fungus" will presently emerge. These are stated to be packed so closely in the containing, much enlarged, plant cells, that (to use the words of Prof. Marshall Ward) these "look like bags of small shot," but they need strong microscopic powers to distinguish them clearly, each spore being only about one six-hundredth part of a millimetre in diameter, that is, about one six-hundredth part of a twenty-fifth part of an inch.



Spores and embryos of "Slime Fungus," *Plasmodiophora brassicae*, after Woronin.
Nat. size of spores about one six-hundredth of a twenty-fifth part of an inch.

Each of these minute colourless spores, or spherules, is composed of a little speck of what is called "protoplasm" (or formative material) surrounded by a cell wall of delicate membrane, as figured at "1." In this condition the spores are stated to pass the winter in the rotten roots, or in the earth where they may have been dispersed by the decaying of the roots in which they were formed. After the "rest" season has passed the spore splits on one side, and the contents gradually make their way out, as figured at "2" and "3"; and at "4" the irregularly shaped growing mass is shown as completely escaped. These masses soon become furnished with a long tail-like process "5," and with the help of these tails, hairs, or cilia, these

* A plain and serviceable account of the life-history of the *Plasmodiophora brassicae*, with some good suggestions as to prevention of recurrence of attack, will be found in 'Diseases of Field and Garden crops,' by Worthington G. Smith (Macmillan & Co.); and in 'Diseases of Plants,' by Prof. Marshall Ward (a small volume published by the Society for Promoting Christian Knowledge), at pp. 47—58, a more especially technical account is given of the history and action of the infestation. For general information these two works are perhaps more serviceable than very elaborate treatises.

minute bodies have the power of moving about. These rudimentary little fungi ("6"), so to call them, can multiply by division, or, on the other hand, several may join together into an irregularly shaped mass called a *plasmodium*. From this the attack takes its name *Plasmodiophora*, signifying *Plasmodium*-bearer. This *plasmodium*, it is found, can now further extend by joining other bodies (*plasmodia*, that is) of the same nature, or by absorbing contents of the spores. It can creep along by the extension of arm-like processes along its sides into which the contents of the body of the mass press forward. "The *plasmodium* is enclosed by a dense hyaline layer, and this in turn is surrounded by a thin coat of mucilage, which mucilage is sometimes left behind by the progressing *plasmodium*, like a trail of slime from a Slug."* From this slimy deposit the name of "Slime Fungus" is derived. Without pursuing the subject in full detail, it may be enough for practical use to add that presently these *plasmodia* divide into minute specks, each of these becomes covered with a fine membrane, and thus once again the infestation is started, as figured at the opposite page.

The method of infestation is for the embryo Slime Fungi to be absorbed by the rootlets, and, when there, cause a distension of the infested cells, and a drag on the juices of the plant to support the fungoid infestation which cause respectively the well-known swellings, and also the loss of growing power in the plant by reason of the abstracted sap, independently of the too frequent total loss of the plant from the subsequent decay.

The gradually advancing progress of the disease in its effects on the form and condition of the affected roots is much more easily observable. At first it may be shown merely by variously shaped swellings of the main or side roots. This is caused by the distension of the cells of which the roots are composed. These enlargements increase until sometimes, as with the form known as Club (see figure at p. 149, after photograph from life), the main root or underground stock is enormously enlarged into a mere shapeless mass; or the long irregular lobes, or finger-like growths, may be found, which, in their swelled and lengthened form, bear the fancied resemblance to Fingers-and-Toes, which have given this name to the lobed form of the disease. This may be found affecting the solid main root, or what would in a healthy state have been the ordinary side roots, until they become irregular tuber or spindle-shaped masses attached by a short length of fairly healthy little swelled root to the main root itself.

The name of Anbury appears to be more especially given to the form (see Frontispiece) in which the root is greatly diseased, swelled, and variously misshapen; but there is not much tendency to the

* 'Diseases of Field and Garden Crops,' by Worthington G. Smith, pp. 95, 96.

Finger-and-Toe-like divisions. Besides the alterations to the general form of the root, the outer skin, or outside of the infested parts, also changes in appearance, and even in a single specimen may show various conditions, which will be seen on examination of the figures, with the help of a moderately strong magnifying-glass.

Besides the large swelled protuberances there will be roughnesses of surface, deep cracks, or burstings open, and patches or spots, even where the skin remains, and in a more advanced state (as shown in the Plate more especially figured as Anbury) the diseased masses in their enlargement may be found to have burst forward from under the skin leaving this forming a hard curving back border over the tumour, the next step to the perishing condition in which all structural distinctions of surface are lost in putrid and loathsomely offensive decay.

Within the affected roots the progress of the disease (that is to say, the gradual spread in the tissues of the presence of the "Slime Fungus") may be traced even in a comparatively early stage by such a marked alteration, both in texture and colour, that I have found it quite possible by my own process of modelling from life to give a precise facsimile copy of the altered condition. Gradually, as the *Plasmodiophora* infestation advances, the attacked parts will be distinguishable by the yellow slimy appearance, and a much enlarged or distended state of the cells of the infested part, until this increases to the general destruction of the root, ending in the putrescence which sets free the spores by millions on millions in autumn, to lie in their resting state ready to germinate next year (as shown at p. 150) and infest whatever suitable cultivated crop or wild plant may be at hand.

Turnips and Cabbage of different kinds are the crops in which the infestation are most observed; but Charlock is a great means of supplying the Slime Fungus with suitable food during the years (when in ordinary rotation of crop) the pest might be dying out, and others of the *Cruciferae* (or allied plants of the Cabbage nature) are liable to attack.

This attack has long been known as one both very prevalent, and causing much loss, but of late years, and especially during last season, much enquiry has been sent, and from some of these notes I give a few observations.

The following communications sent me by Mr. G. G. Blantern, from Balderton Hall, Myddle, near Shrewsbury, refer to the attack, from specimens of which the figures on the accompanying Plates showing the conditions commonly known as Anbury, Finger-and-Toe, and Club, were afterwards, at my request, forwarded to me in order that we might have thoroughly characteristic representations.

On Oct. 6th, Mr. Blantern first wrote to me on the subject, mentioning:—"I send you by parcel post a Turnip and a Cabbage plant,

and should be glad to know what you think of them. The Cabbage plant we consider a true case of Finger-and-Toe." It was also mentioned that no similar disease had previously been observed in the neighbourhood. The specimens sent were quite certainly of the diseased growth known as Finger-and-Toe, and in the case of the Turnip much putrified at the lower part of the root.

Somewhat later, at my request, Mr. Blantern favoured me with the following details:—"My Turnips were sown from the 20th to 24th of May on a 20-acre field of 'red loam,' which has been farmed on the four-course system for 30 years! No Charlock has been grown. The manure used was the following: raw bone meal 4 cwt., mineral superphosphate 3 cwt., salt 1 cwt., per acre. The Turnips looked *remarkably* well until the first week in July, when they suddenly dropped their leaves, and upon examining the roots a disease was visible; since then they have gone from bad to worse: about 10 acres have entirely disappeared; 5 acres have lingered on, and are similar to the specimens I sent you. The remaining 5 acres, though partially attacked, I estimate at about 15 tons to the acre.

"The Turnip crop generally in this neighbourhood is very heavy this year, and had my crop finished as they promised to do in July last, I should think my weight per acre would have been from 25 to 30 tons at the least. From this you will understand that the loss to me is *most serious*, as well as being especially disappointing."—(G. G. B.)

The following communication was sent me on August 3rd from near Collumpton, Devon, with specimens of "Anburied" roots accompanying, by Mr. T. Pitt:—"I am sending you by the same post some specimens of Swedes attacked by 'Fingers-and-Toes,' or 'Anbury,' in an early stage." . . . "I have the plants, sown about June 24th, attacked both in heavy and light land (gravel); the former, after ley, Wheat, the latter, after ley, Barley, both ploughed last autumn, but worked out this spring, owing to the very unfavourable autumn of 1891; both manured with farmyard manure this spring, and 1 cwt. of guano, and 3 cwt. of dissolved bones per acre, and 4 cwt. of kainit per acre sown broadcast in spots for trial." . . . "Charlock is also badly affected. I believe it is rather general in this neighbourhood: last year we had little or none."—(T. P.)

From near Rotherham, Yorks, enquiries were sent with the observation:—"The farmers in this neighbourhood have for some years suffered loss by their Turnips 'Finger-and-Toeing'"; and from Mr. Leonard, of Preston, Hull, I had a note that he was informed by several growers that in the Selby district (also in Yorkshire), where a little brown Mustard seed is grown, that for a year or two after it, if the land is sown with Turnips, they almost invariably "Finger-and-Toe."

From near Burton-on-Trent, in Staffordshire, a correspondent reported about twelve acres of Turnips having gone like the specimens sent, which were decided examples of Anbury.

From Penrith, in Cumberland, on the 23rd of August, badly "Anburied," or "Finger-and-Toed," Turnips were sent me with enquiries as to the cause of that disastrous scourge to Turnip crops known as Finger-and-Toe. I had also a communication from another correspondent relative to the serious loss caused by prevalence of this attack in Cumberland generally.

To these I may add a note from a locality near Shortlands, Kent, sent with badly Clubbed roots of plants of Brussels Sprouts accompanying as samples of an attack, of which the sender remarked:—"I find the whole of my plants of the Cabbage tribe are all affected, and are all dying off."

The above notes are given partly to show (with the addition of some others to be referred to further on) the widespread presence of this destructive infestation, whether in the northern or midland counties, or in the westerly or easterly extremities of the island. Partly also to show that even in these few notes the presence of the disease on Turnips after a preceding growth of some weed like Charlock, or cultivated crop as Mustard, is observable practically. Also it is, I think, an important point to observe that perhaps hardly an enquiry was sent me regarding Finger-and-Toe, without a suggestion on the part of the sender that the disease was due to insect infestation, and of these samples of diseased roots, I did not find one in which (though insects might also be there) the condition was not clearly and demonstrably due to the Finger-and-Toe disease caused by "Slime Fungus," *Plasmodiophora brassicæ*.

This point, that is, the fact of Finger-and-Toe disease having a known history of its own, and known methods of prevention, independently of insect attacks which may occur with it, is very important to be kept in mind, and want of this knowledge may reasonably be supposed to be one cause why the infestation is so often allowed to establish itself.

PREVENTION AND REMEDIES.—As the amount of presence of the Finger-and-Toe disease has been found to turn in part on the nature of the soil, so preventive measures turn also in part on applications which will supply what is needful for the plant, and also be obnoxious to the Fungus. Also attention is needed to such treatment as, by chemical dressings, measures in cultivating the infested land, and removal of infested remains, also in non-use of manure to which infested roots have been thrown, may respectively destroy the Fungus in the ground; give clean, or comparatively clean, land for the next

“infestable” crop, and prevent manure full of Fungus spores in rotted matter from Turnips being brought back to it. Also a rotation of crop, and a freedom from weeds liable to infestation, so as to give time for the Fungus to perish for want of food after germination, are very important matters.

With regard to nature of soil.—In the paper on ‘Anbury, and the analysis of Diseased Turnips,’ by the late Dr. Augustus Voelcker, Chemist to our Royal Agricultural Society,* he observes as follows:—“It is well known that Turnips grown upon light sandy soils are much more frequently affected by “Anbury,” or “Fingers-and-Toes,” than roots grown on stiffer land, containing a fair proportion of the four chief components of all soils—clay, lime, sand, and vegetable matter.”

Dr. Voelcker, after further remarking on presence of this attack being influenced by “absence or insufficiency of lime in light sandy soils—hence the manifest benefit with which lime, chalk, marl, shell-sand, and other calcareous manures are used as preventives of this and similar diseases in Turnips”—further notes:—“But at the same time it must not be supposed that the absence or deficiency of lime in land is *always* the cause of Fingers-and-Toes in Turnips, and that liming is a *universal* preventive of this disease.”—(A. V.)

In the year 1859, when Dr. Voelcker’s paper was published, the clue was still wanting to the reasons why a state of soil which sometimes was highly beneficial, sometimes also was no preservative. It was not until the year 1876 that the true nature of the fungoid disease which causes Anbury was known; and the following observations, with which, at my request, I was kindly favoured by Mr. Gilbert Murray, from the Estate Office, Elvaston, gives a very good sketch of how the matter stood:—

Anbury, or Finger-and-Toe.—This is a troublesome disease, which affects the *Brassica* tribe; it has long been imperfectly understood, and its origin attributed to various causes. I have known farms where roots could not be successfully cultivated owing to the certainty of the appearance of the disease; it is more common in wet than in dry seasons in soils rich in humus. There is little doubt a too frequent repetition of the root crop on the same land is a contributive cause by the abstraction of a large quantity of potash and lime from the soil. Recent researches have traced the source of the disease to living organisms in the soil, the germs of which may, under favourable conditions, remain dormant in the soil. For several years I have known cases in which lime has been successfully used. Lime is not a manure, and hence its use is not desirable on tillage land, as it liberates the

* See Journal of the Royal Agricultural Society of England, 1st series, vol. xx., p. 101.

fixed nitrogen in the soil, which then takes the form of ammonia, one of the most volatile gases known to chemists. A mixture of gas-lime and salt has been tried with varying success." . . . "A mixture of superphosphate and kainit, and an extended system of cropping, will in general prove effective."—(G. M.)

Some further very serviceable suggestions of Mr. Gilbert Murray's are given further on.

But returning now to the observations of Dr. Voelcker, at pp. 102—104, in the paper previously quoted, some notes will be found of the excellent effect of gas-lime as a preventive of the disease, which are well worth consideration. Dr. Voelcker notices that in a field of considerable extent at Ashton Keynes, near Cirencester, the Turnips were affected by Anbury to an extent such as he had never seen before. "There was hardly a sound root to be seen, except on two isolated patches." The rest were all more or less attacked, exhibiting "the characters of Anbury in its most malignant form."

On examination of one of the two isolated spots, not many yards square, it was found that the Turnips, though not large, were nearly all sound, and on investigation as to the nature of a whitish looking substance resembling gas-lime which Dr. Voelcker found on examination of the soil, he learned that on this spot a cart-load of gas-lime had been unloaded the year before.

In my own experiments as to effect of this application as a remedy for presence of Club in Cabbage on badly infested ground, I have found it to act perfectly, clearing the disease absolutely out, so that where the roots had been perfect masses of malformation and rottenness, the succeeding crops were free. This was whilst I was for some years resident near Isleworth, and it may perhaps bear practically on the subject, and be of interest to notice, that from the attention drawn during those years in that great Cabbage growing district to the serviceableness of gas-lime as an application, that the price rose from being procurable for cost of carting, to 7/- or 7/6 a load. On speaking of the matter to Mr. Wilmot, one of the chief growers of the neighbourhood, he simply remarked, "We could not do without it."

In the analysis taken by Dr. Voelcker of soil in different parts of the field near Cirencester, he found that on the Anburied parts the amount of lime was very trifling, and in the surface soil especially "totally inadequate to meet the requirements of a crop of Turnips, whilst in the case of the two patches which almost entirely escaped attack, in one instance there was much lime in the shape of gas-lime, and in the other much more lime than in the parts of the field where the root crop had failed through Anbury."

From what we have learnt of late years of the cause of the Anbury disease there appears every reason to suppose that lime or gas-lime, if

applied in caustic state, would be beneficial not only by its subsequent effects on the crop plant, but by its immediately destructive effects on the Fungus spores, or the exceedingly minute Slime Fungi, when germinating, but in whatever way it may be brought about, the good effect of the application is definitely recorded by Dr. Voelcker.

In his leaflet on the use of gas-lime in agriculture,* Dr. Voelcker notes (p. 4), with regard to the attack on the Turnip field above alluded to:—"At my recommendation the occupier applied a heavy dose of gas-lime, which completely cured the evil." Also in the same publication it is noted:—"A large dose of gas-lime applied to the stubble land in the autumn before it has been turned up by the plough, in many instances, is an effectual cure for this disease."—(A. V.)

The strength of the dose of course varies with circumstances, but if put on at above date, when the land can be left untouched for six weeks or so, to allow the gas-lime to oxidise, two tons per acre might be used. The gas-lime should be put on in fresh caustic state, and as in this condition it poisons or destroys plant, and also insect life, thus being a most effectual remedy for many field troubles, time must be given for the changes in its chemical nature to be carried out, by which, when lying exposed to the action of the air, it changes to a manure of the nature of gypsum, a safe and beneficial dressing for many crops.

In some instances lime and soot have been found to answer in checking Club presence, as noted in the following observation from Mr. Eyden, the head gardener to S. Berger, Esq., of Bragbury, Stevenage, Herts. In this case the Club was extirpated, and as Mr. Eyden's experience extends over 22 years, his observation is valuable, but it would be of interest to have special further observations to ascertain clearly whether this would not equally be the case if the lime only was used, without the admixture of soot.

Mr. Eyden wrote as follows:—"When I first came here I had whole breadths spoilt of Broccoli and Cauliflowers, which have been more subject to attack here than any other green. The first year I was here I found I had got a bed of plants attacked; I pulled all up and burnt them. I simply sowed some lime on the ground and replanted it, dipping the roots of each plant in sooty water before planting it, and when taken up not one root was in the least affected. Since then I have always treated them in the same way, and have had very few Clubs."—(W. E.)

* See four-page leaflet 'On the Composition and use of Gas-lime,' by Dr. Augustus Voelcker, Prof. of Chemistry to the Royal Agricultural Society of England. Printed by King, Sell, and Railton, Gough Square, E.C. Procurable by any bookseller. This is a most useful leaflet, full of practical as well as scientific information.

One of the most important measures, however, for keeping the attack in check is securing clean ground for the crops.

Where infested roots are left about, all the spores of the "Slime Fungus" (see p. 150 for description) will be ready to start new attack. In the words of Prof. Marshall Ward, p. 55 of work previously quoted, "All the hundreds of thousands of them contained in the malformed roots above described will be set free in the soil as the roots decay, or into the manure heaps on which they may be cast to rot."

This very important consideration is strongly urged in the following note, with which I was favoured by Mr. Gilbert Murray:—"Care should be taken not to use the roots affected by the disease for the feeding of stock, or in any way where they can become mixed with the farmyard manure, otherwise the germs of the disease are again conveyed to the land, and thus perpetuates the disease you wish to eradicate."

Care also should be given to gathering up all remains of infested roots on a field that has been attacked, and burning them. If they are merely ploughed in, the spores will germinate, just as weed seeds might germinate in similar circumstances; and though a *crop* liable to injury will not in common farm practice be on the land for several years, there are various common weeds, and most especially Charlock, which may keep the Fungus supplied with food for its successive generations until the time for a crop liable to infestation, as Turnips, Swedes, or Cabbage, comes round again.

As yet we do not know on what the young Slime Fungi feed if the plants which we know of as their regular food are absent from the soil. In a dried state the spores will live for years. This does not apply most certainly to the state of our fields, but yet from the recurrence of attack there appears to be no doubt that the infestation has had some congenial nourishment, even when what we recognise as such was not noticed.

To give one more quotation from Prof. Marshall Ward, which well describes the progress of the affair:—"The spores lie, as we have seen, in the cells of the root, like shot in a bag, and remain quiescent during the winter, becoming set free into the soil as the root rots, and lying there ready to germinate as before in the following spring, when their progeny will have good times once more if fortune favours them in the shape of new crops of plants of the Cabbage tribe.

"What they will do if no such plants are put into the ground no man knows, though it is certain many millions of them die every year. It is not improbable that they can support themselves to some extent as saprophytes, but this is not yet demonstrated."

But with the knowledge that the spores (that is, the minute live specks, which in plants of this nature answer to a certain extent to the

seeds of flowering plants in being a point from which a new plant springs) we have definite knowledge to act on.

Such measures as clearing away infested roots from the fields instead of ploughing in the remains ; on no account allowing manure to be infested by letting roots rotting from this disease to be thrown to it ; ploughing to a depth which may bury down the spores so deeply that they will not be brought up again, and such rotation of crop (and eradicating of weeds liable to infestation) which will give time for the brunt of the Slime Fungi to have died out before new sowings of Turnip or Cabbage are submitted to them, are measures which will all tend to lessen presence of the pest. So also are dressings of the land, which may destroy the pest outright in the surface soil, and which may supply the food needed for the crop growth.

All these measures are quite sure to do good ; but also (indirectly), I think, we should much benefit by it being generally known that this attack of Anbury, Finger-and-Toe, or Club is *entirely and absolutely* distinct in its nature from any insect attack.

Applications of lime and gas-lime, and also destroying infested roots, are good measures for checking various of the Turnip and Cabbage-root insect attacks which are most frequently confused with Finger-and-Toe ; but there are points in which the treatment for these and for the Fungus disease run on quite different lines, and from the specimens and enquiries sent to myself, I should say that both valuable crops, and cost of labour and applications, were being wasted year by year for want of just a very little knowledge, which would immediately give the key to open out to each grower, from his own consideration of the subject, the course of treatment needed.

APPENDIX.

MANGOLDS.

IN the course of recent examinations as to the nature of stores long left undisturbed in the upper story of an old house, near Naseby in Northamptonshire, the researches brought to light many numbers of an agricultural journal, published weekly early in the present century. Some numbers of this paper, Evans and Ruffey's 'Farmer's Journal and Agricultural Advertiser,' were placed in my hands by the kindness of a friend, and proved of much interest from the mass of agricultural record, including weekly returns of market prices, and good correspondence on agricultural topics. But amongst the notices of root crops, the observations on method of cultivation of Mangolds, then recently introduced into this country, suggest one or two points which, in the gradual change to the more correct principles of growing of the present day, may coincidentally bear on the increase of leaf maggot during the last twenty years.

The first introduction of Mangolds as a field crop into this country is variously ascribed by different writers to Thos. Boothby Parkins in 1786, and to Dr. Lettsom in the year 1790, or thereabouts; but from the correspondence and advertisements, &c., given in the number for April 8th, 1816, it is evident that the growing of Mangolds was then being pushed forward into notice, under leading agricultural influence, against much opposition.

In the number above quoted we have an advertisement of Mangel Wurzel seed at 2*s.* 6*d.* the lb., being procurable from Messrs. Gibbs, "Seedsmen to the Honourable Board of Agriculture." Seed was also procurable at 3*s.* the lb., or 2*s.* 6*d.* the lb. in large quantities, from Mr. Geo. Lindley, of the Catton Nurseries near Norwich, another important centre; and a specially carefully saved kind was procurable from Leonard Phillips, proprietor of a large Nursery and Agricultural Experimental Establishment, Portsmouth Road, near Vauxhall, "adjoining the two-mile stone from Westminster Bridge."

This seed was 5*s.* the lb., but Mr. Leonard Phillips appears to have been the leading man in working forward acceptance of the new crop, as we find that the Society of London for the Encouragement of Arts,

Manufactures, and Commerce, awarded him a gold medal for his successful exertions in extending the culture of this root, "called in German, Mangel Wurzel," and for "removing the prejudices against this valuable vegetable." With the seeds a pamphlet was in some cases sent out, with directions as to cultivation, and from such points as are accessible of these it appears, that (in this country), at the date of 1816, the value of the Mangolds, as supplying green food by successive removal of a portion of their leafage, was much more looked to than at the present day.

Full details are given by Mr. Phillips of his disleafing operations and their results, which given shortly show that from his plants, grown at two feet distance, he took six successive cuttings of leaves, proving of much service for feeding to milch cattle in a season of drought, and the roots, when raised in November, run from 20 lbs. each, upwards, to a few lbs. more.

In a report, published in the same number of the 'Farmers' Journal' (April 8th, 1816, p. 127), we have detailed observations on the "Culture of Beet-root,"—"Abridged from the Instructions of the Agricultural Society of the Department of the Seine (1812)," and published by the Editor of the 'Farmers' Journal' in translation, that his readers "may compare the practice in France with their own, in the culture of Mangel Wurzel or Lettsom Root, now spreading so fast, and so deservedly, in this country." Here, under the head "Stripping," it is observed: "When the leaves are a foot long they may be taken off." This may be repeated several times, taking care to leave those in the middle. To avoid hurting the root, they must be stripped from the inside downwards. "Cattle, and particularly cows, eat the leaves with avidity. This stripping, it is true, diminishes the size of the root, but it affords good forage in dry summers."

So far as I find, from much search, this plan of removal of the leaves (that is of some portion of them) was much more followed formerly than at the present day. This was certainly to be expected, as, with increase of knowledge of the reasons and principles of plant-growth, no one was likely to remove what are equivalent to the lungs and digestive powers of the plant without good reason. Still the application of the rule may be open to exceptions.

It is noticed by Prof. Wilson, regarding this point, of the advantage asserted by some cultivators of Mangold, to occur in the plant* furnishing leafage for food as well as roots, that "This practice, which is quite opposed to our knowledge of vegetable physiology, was far more general a few years back than it is now" (this was published

* 'Our Farm Crops.' By John Wilson, Prof. of Agriculture in the University of Edinburgh. Vol. I., p. 429.

in 1859). "As there are many, however, who still adhere to it" . . . Prof. Wilson proceeds to discuss the subject at length. Looking over observations of experiments in various places the record is, as might be expected, quite in favour generally of largest weight of root occurring where leafage was left. Still this result is not invariable; in the records of the trial at the Model Farm, Glasnevin (see 'Agricultural Gazette,' January 7th, 1860, for full details), it was shown that of two lots of a similar kind of Mangold, each sown on the same day, treated in the same manner, and each raised on the 27th of October, those from which 5 tons of leaves per acre had been stripped gave a return of 45 tons 1 cwt. of roots per acre, whilst of those from which no leafage had been taken, the return of roots per acre was 40 tons 8 cwt. 6 qrs. *Turning now to possible preventive benefit by some leaf-stripping.*

Without venturing to express an opinion myself on the agricultural bearing of the case, I should *conjecture* that so far as growth of good roots was concerned it was much the safest course to follow the usual principles of growing, and let all useful leaves remain. *But in fighting this increasingly troublesome prevalence of Mangold leaf-blister maggot, it appears to me, from the above observations of treatment, that the plan of removal of a part of the leafage might be much more adopted, both as a remedy and preventive, than has hitherto been the case. It is a curious coincidence that the first notices of the maggot mischief began not long after the plan of removal of outer leafage was observed as being much less than formerly. This last was about 1860. I have notes from Mr. Watson Hornsby, of Holme Cultram, Cumberland, that though the first really severe attack of the Mangold leaf-maggot, that he noticed, was in 1876, yet for some years before, similar attack, on a lesser scale, had been noticeable.*

It is unnecessary to go into details of application to any of my agricultural readers. It has long been known to be one way of checking further increase of attack, to pinch the maggots in the leaf-blisters, or to nip these pieces out. But independently of all evident drawbacks to this plan (even whilst the plant is still young), after a while, when the leafage becomes of a fair size, the pinching out plan becomes impossible. At this date, and afterwards, it would probably save a great amount of continuance of attack in infested fields to have the leafage much more removed than (as far as I know), we generally have ventured to do. Of course it should be done under exact instruction of a superintendent as to how many of the outer leaves might be safely removed; and the removal should be carefully done, so as not to bruise or injure the crown of the root. Where the leaves are maggot-infested we have obviously the gain of this much nucleus of future infestation being removed, and there are very many cases in which the removal of the partially

destroyed outer leaves, or even the healthy ones, would do good to the crop by giving enough space for air and light and sunshine-warmth to come round the plants and on the earth.

Setting the loss, certainly caused by recurrence of attack, against what *might* happen by lessening weight of root by removal of some leafage, it may perhaps be thought desirable in the coming season to experiment in this matter, taking care if the leaves are so infested as to be useless that they shall be *destroyed* at once, not merely thrown aside. Where there is little maggot presence precaution may not be needed, as rapid consumption by the cattle, use of salt, scalding the troughs, or throwing quicklime where any heap of leaves might have lain, would probably get rid of any risk of infestation, or at least of infestation to a serious extent; recurring from the transported maggots.

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With compliments
from the writer.



West, Newman photo.

TOMATO-ROOTS

Galled by attack of *HETERODERA RADICICOLA*,
about two-thirds natural size.

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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS,
DURING THE YEAR 1893,
WITH METHODS OF
PREVENTION AND REMEDY.



SEVENTEENTH REPORT.

BY

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PREFACE.

THE past season of 1893, looked at from the point of agricultural entomology, has been remarkable for the effects of the unusual meteorological conditions (notably the long-continued drought) on the amount of various kinds of insects, and of other crop and fruit and forest infestations, and also the effects of this presence on the infested crops.

For those who wish to study the records of the 'Spring Drought of 1893,' much excellent information is given in the paper by Mr. G. J. Symons, F.R.S., published in Part II. of the fourth volume of the *Journal of the Royal Agricultural Society**; but for just a short statement as a general guide to date, locality, and amount of deficiency of rainfall, the following few lines, extracted from the paper by Mr. Fred. J. Brodie, F.R.Met.Soc., entitled 'The Great Drought of 1893,'† may be serviceable in connection with some of the observations in the following Report on variation in amount of insect infestation.

Mr. Brodie observes:—"Enquiry showed that although an unusual amount of fine weather was experienced over England during the greater part of 1893, the drought itself was confined to the spring and early summer months. The finest and driest weather of all occurred in the ten weeks commencing with the beginning of March, and ending with the middle of May, but a great deficiency of rain continued in most districts until the end of June, and the period selected for investigation therefore included the whole of the four months, March, April, May, and June."

Further on in the same paper Mr. Brodie notes:—"Taking the period of four months as a whole, the aggregate rainfall amounted to less than half the average over the entire southern and eastern half of England, as well as in certain portions of Durham and Northumberland. Over a considerable portion of our southern counties, as well as in Cornwall and South Wales, the fall amounted to less than one-third of the average; the only southern localities in which this proportion was exceeded being some of the more central parts of Devonshire."—(F. J. B.)

In the following Report it will be found that the severity in

* 'The Spring Drought of 1893' (with Tables and Maps), by G. J. Symons, F.R.S. *Journal of the R. A. S. E.*, Third Series, Vol. 4, Pt. II., pp. 339—354.

† See 'The Great Drought of 1893,' by F. J. Brodie, F.R.Met.Soc. Pt. IV. of Vol. quoted above, pp. 849—856.

amount, or peculiar development, of some kinds of crop injury as of that caused by Gout Fly Maggot, pp. 6—11, is clearly referable to unfavourable circumstance for plant growth, laying the plants more than ordinarily under the power of the maggot; in others, as with the Gooseberry Red Spider, pp. 32—38, the amount of proagation was favoured by weather which left the myriads of pests unharmed by soaking or clearing rains; and the great prevalence of Wasps was another entomological visitation obviously in great part due to the absence of unfavourable weather at the time of commencement of their settlements; prevalence of Aphides was also favoured by the same conditions.

In the course of the year, I received enquiries regarding about (or upwards of) 145 distinct species of infestation; these for the most part asking information regarding field and orchard insect pests, but including among them what are often known as insect allies, as the "False Wireworms," or Millepedes; Gall Mites, and Red Spider, belonging to the Acarina; "Stem" and "Root-knot" Eelworms (scientifically, Nematodes); and also the excessively minute six-legged creatures belonging to the division of the "Springtails" (scientifically, *Collembola*), which do mischief to roots underground, and in various other ways, and of which both the leaping and non-leaping species were sent me.

Amongst crop attacks, the points regarding Mangolds which were sent me included Leaf-maggot, Surface Caterpillars, Aphides, and the "Pigmy" Mangold Beetle noticed in my Report for 1892, which was again reported to me by Prof. Harker, from the Royal Agricultural College, Cirencester; Mustard was infested in various localities by its different beetle enemies, from the sprouting of the seed in the ground to its final flowering and seed stages; Peas, Beans, and Vetches had their respective attacks, mostly of beetle infestation in the seed for sowing, or of another kind of weevil, the *Sitones*, on the leafage, or of Aphides smothering the plants,—this latter damage to the Beans being in some instances little lessened, and that to the reapers very much increased, by the numbers of Wasps attracted to the "Plant Lice."

Corn, taken generally, did not appear to be seriously attacked, although Barley suffered greatly in some places from Gout. Frit Fly Maggot was also present; and Hessian Fly was a little reported to me, the first record being sent by Mr. D. D. Gibb, from Ossemsley Manor Farm, Lymington, Hants, received June 27th. Attack of maggot of Corn Sawfly was not once reported; but it certainly did occur to me whether if one or two instances, where serious damage to crop by Hessian Fly was reported, it might not have turned out (as sometimes in 1887), if more critically examined, to be in part due to the falling of the straw from Sawfly Maggot presence. Aphis attack was little reported on any kind of corn. Various moth and weevil attacks to corn stacked, or in granaries, were more noticed than is commonly the case.

Grass suffered very severely (see pp. 22—31) in various places, especially in the south-east of England, from the maggots of Rose Chafer, an attack liable to be confused with that of the Cockchafer; and a little moth, without any very descriptive popular name (scientifically, the *Pyralis glaucinalis*), was found in one locality infesting the outer portions of hay, and other kinds of fodder, stacks, to an inconvenient extent.

The infestation of Diamond-back Moths, which in 1891 caused so much mischief to Turnip and Cabbage leafage, especially along our eastern coasts, and which were to some extent present in 1892, was hardly reported last year; and where careful examination was made, by request, in the districts round Hartlepool and King's Lynn, where it had been especially prevalent, the infestation was last year notably absent. Other common pests were present, as Surface Caterpillars of different kinds, Cabbage-root grubs, Aphides, &c.; these last in one instance to such a great amount as to attract such vast numbers of Ladybirds (*Coccinellidæ*), that measures were being set on foot to destroy these helpers as being the cause of the mischief! On Hops also (which suffered so severely in some places from Red Spider that the cutting had to be hastened), a very small kind of Black Ladybird, the *Scymnus minimus*, was found to be very serviceably at work as a "Red Spider" eater.

The "Root-knot" Eelworm, *Heterodera radicolica*, affecting Cucumber and Tomato roots, has been made the subject of very careful experiment regarding effects of chemical applications to infested soil or plants (see pp. 103—108).

Onions (which were much attacked by maggot last year), Carrots, Potatoes, and other ordinary field and garden crop infestations, were enquired about in their season, as well as forest injuries, amongst which Aphis attack in various forms, and notably the troublesome Larch Chermes, were present. These were all duly replied to as they occurred, and entered, with date and name of sender, in my books, which now have been daily kept for many years, so as to form a kind of index of reference. But as the main points of the history and methods of prevention (so far as known) of our common attacks which have been entrusted to my care for publication have been in many cases embodied in my Annual Reports, of which the present is the seventeenth of the series, it has seemed unnecessary to repeat the observations.

Therefore in this year's Report I have endeavoured, so far as I could, to omit notice of the well-known attacks, excepting where some additional point of information, or some peculiar development coincident with the peculiar weather conditions of the year, appeared worth noting.

Amongst attacks injurious to the fruit industry which now holds such an important position, it might be said that almost each kind of orchard tree, or bush, or ground-growing fruit, had

its customary infestations, with some not usually present. Amongst the latter was the appearance of the magnificent caterpillars of the Lappet Moth, four inches or more in length, on Apple; and the great prevalence of the kind of Red Spider, usually infesting Ivy, on Gooseberry; and, also on Gooseberry, some observations of the so-called Currant Scale Insect.

Locusts, as an import in hay, or fodder, have come more under notice than usual; and under the heading of *Phytophidæ* will be found notes on the Gall Mites, with quotations and references to the exceedingly valuable series of publications now being issued by Dr. Nalepa on this difficult class of plant pests. Wasps also being a visitation which involves very universal trouble to everything they think fit to bestow their irritable or appropriative attentions on, are placed under the heading of their own name.

Warble prevention gains steady attention, and the distribution of leaflets (amongst other centres from the Irish Cattle Traders' Association) cannot fail to be doing good.

Besides home work, colonial applications were sent regarding insect infestations to tropical produce, as Sugar Canes, Oranges, Coffee, Tea, &c., these being sent through the hands of London correspondents of the infested districts in the West and East Indies, &c., or from owners, or societies, as the case might be.

In regard to such usefulness as my work may possess, I greatly wish to point out that this rests in great part primarily on the observations with which I am favoured by agriculturists, and other observers, of what they notice as to presence, and effects of infestations, and the treatment which demonstrably answers for getting rid of these; and I earnestly wish that our farmers and fruit-growers would bear more in mind that very often much of the treatment which they are advised to adopt is in reality the recorded result of their own practical experience.

To the agricultural press I am constantly indebted for their steady and encouraging support and assistance in my work; and also I beg to offer my grateful thanks for co-operation to the leading entomologists at home, whose assistance I have acknowledged in the papers connected with the insects which they have been good enough to aid me in identifying. I am also much indebted similarly to Dr. A. Nalepa, Professor at the Imperial Academy of Vienna, for his great assistance to me, and instruction bestowed on me, in connection with the difficult study of *Phytophidæ*; also to Dr. Schøyen, State Entomologist, Christiania, for much useful entomological information kindly given, including information of the first recorded appearance of the Hessian Fly in Norway. To Dr. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, I am again (as each year) indebted for unfailing assistance in identification of Nematodes, commonly known as Eelworms, as well as kind co-operation; and to Senor Don Ignacio Bolivar, Professor of

Entomology at Madrid, I offer my sincere thanks for being good enough to identify for me the specimens of Locusts which I transmitted for benefit of his skilled opinion. With Mons. J. Danysz, Director of the Laboratory of Parasitology (Bourse de Commerce), Paris, I had the advantage of a little communication early in the year regarding the serious mill scourge, the Mediterranean Flour Moth (*Ephestia kuhniella*); and on his favouring me with a copy of his valuable pamphlet on the subject, it appeared to me that I could best co-operate in spreading information by requesting my booksellers to import (at my own risk) a certain number of copies, so that those concerned might see the subject *in extenso*, and the copies meeting with circulation, I have thought it unnecessary to enter on his information fragmentarily in my Report.

To Mr. J. Fletcher, Entomologist and Botanist of the Department of Agriculture, Experimental Farms, Canada, I am indebted for constant kind co-operation; and to the many other good friends who help me, who are too numerous to mention, I beg to offer my hearty thanks for their aid and encouragement. I should fail in courtesy if I did not also offer my best acknowledgments for the valuable and helpful gifts of entomological books (of which I am frequently in receipt), including amongst these the liberal gifts for which I am indebted to the courtesy of our own Canadian Government, and to the Department of Agriculture and Experimental Stations of the United States.

Of the 33 figures given in the following Report, those on pages 5, 6, 11, 22, 46, 54, 59, 60, 61, 62, and 95, are by kind permission of Messrs. Blackie & Son, Glasgow; the beautiful figure of the *Aceridium americanum* at p. 51 is after a drawing by Prof. Riley; the Pear-leaf *Phytoptus*, and the feather-claws, p. 108, by kind permission of Dr. Nalepa; and the Pear Sawfly, p. 79, from one of the blocks I have been permitted to use by the proprietors of the 'Gardeners' Chronicle.' Of the remainder, the figures at pages 1, 15, 32, 39, 47, 74, and 84, are drawn (chiefly from life) during the past year for this Report.

It is a great gratification to me to find that the amount of insect enquiry sent to my hand, and which I think it a great honour to be entrusted with, increases rather than lessens in scope and in interest of points sent for examination; and it shall be my earnest attempt, by every attention that I can bestow on enquiries sent, to endeavour honestly and soundly to be of service.

ELEANOR A. ORMEROD,

F. R. Met. Soc., and F. E. S.

TORRINGTON HOUSE, ST. ALBANS,
February, 1894.

LIST OF
ATTACKS OF INJURIOUS INSECTS, &c.

NOTICED IN THE FOLLOWING REPORT.

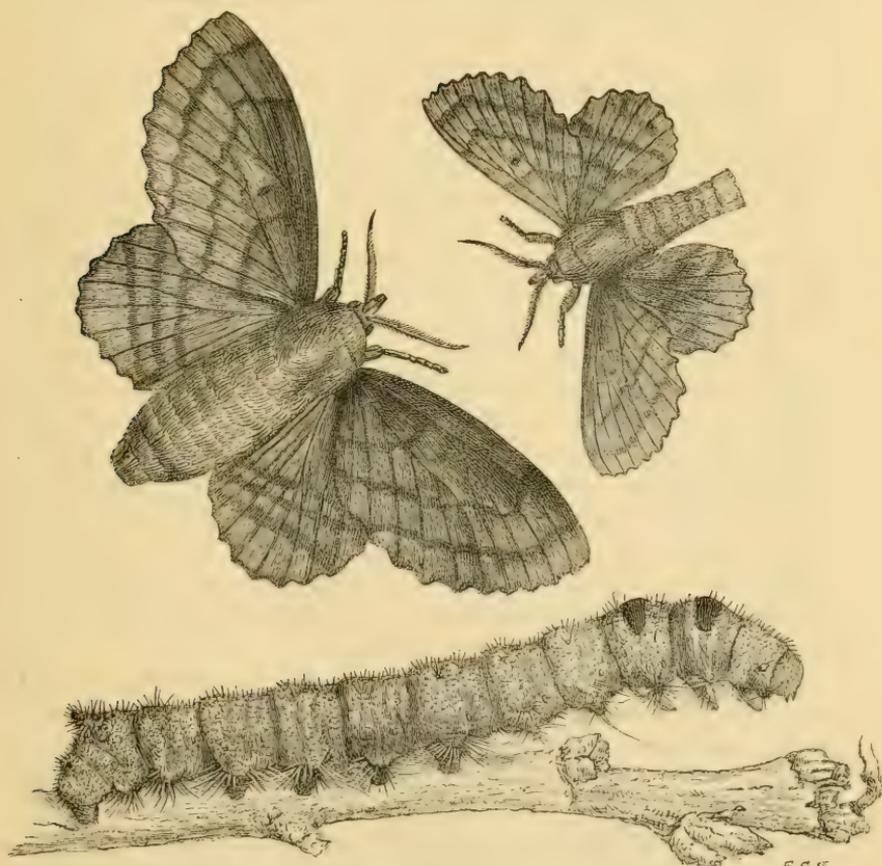
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* The Minute Black Ladybird Beetle, the *Scymnus minimus*, is beneficial by destroying Red Spider. In the above list only the names of the chief infestations entered on in the following Report are specified.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1893.

APPLE.

Lappet Moth. *Gastropacha Quercifolia*, Linn.



F. C. K.

GASTROPACHA QUERCIFOLIA.—Lappet Moths, male and female, and caterpillar, also
Apple twig with leaves eaten away; all from life.

THE very conspicuous presence of the caterpillars of the Lappet Moth, which when full-grown reach a length of four inches or more, has long been known of in this country as occurring on Willow, also on Sloe or Blackthorn, and sometimes on Pear, and on Whitethorn; but it was not until last season that I had an observation of the infestation as seriously injurious to orchard leafage. In this case the attack was reported early in May to me by Messrs. Cranston, of King's Acre, near Hereford, as occurring here and there on their Apple trees, and that where they were found, every leaf had been devoured.

The little bundle of Apple twigs sent accompanying as samples of the ravage, showed this to have been total, as all was cleared excepting just the remains of the leaf-stem. The above sketch of part of one of the twigs sent me shows the extent of the injury, and the figure of the caterpillar, taken from a specimen which was the counterpart of the sample forwarded to me, shows its great size, and also shows the row of fleshy appendages along the side (fancifully compared to lappets), from which the perfect insect takes its popular name of "Lappet Moth."

The caterpillars of this "Lappet Moth" grow to a length of from four to five inches (the specimen before me is somewhat over four inches long), and are cylindrical, slightly hairy, and grey or brownish in colour, but the tint is variable, and so also is the pattern of the markings down the middle of the back. These may be almost absent, or may occur as a row of somewhat V-shaped dark marks; but across the back, on the segments next the head, are two beautifully lustrous, deep blue or purple, velvety bands. These are characteristic markings, and are especially observable when the caterpillar is in movement; when at rest they may be hardly noticeable. The caterpillars have three pairs of claw-feet, and four pairs of sucker-feet beneath the body, besides the pair at the end of the tail; and just above the feet, and all along each side is a row of fleshy warts or appendages with long grey hairs, to which the name of "lappets" has been given. These peculiar excrescences have been carefully figured from a specimen in my possession (by Mr. E. K. Knight), so that their position and form should be clearly distinguishable from that of the claw and sucker-feet, with which they are sometimes confused.

When full-grown, which may be in the late spring or early summer, the caterpillar spins a dark coloured oval cocoon, apparently in any convenient shelter, as the localities are variously recorded as being in clefts of bark, or between boards under eaves, or amongst the lower twigs of the plant on which the caterpillar fed, or close to the ground amongst grass. From these cocoons the moths appear at variable dates from June (or even as early as May) to July and August. These moths, scientifically the *Gastropacha Quercifolia*, are very fine

insects, the females being sometimes as much as three inches and a quarter in the spread of the fore wings; of the two specimens before me, the female is just above three inches, the male just above two inches in expanse. The colours are rich brown, marked transversely on the fore wings with three irregularly disposed dark scalloped lines; the hinder wings are somewhat similarly marked, and the hinder margins of both wings scalloped or indented at the edge. When at rest, the fore edge of the hind wings, which is somewhat dilated, projects, so as to be very noticeable, beyond and from under the fore edge of the fore wing, thus giving an appearance much like a dead brown leaf to the moth, which probably often secures it from observation, and from which it takes its specific name of *Quercifolia*, or "Oak-leaf."

The early life-history of the caterpillars is stated to be for them to hatch in September, and to moult once, and to spend the winter extended on a twig of their food-plant, and in the following season to complete their growth. This autumn appearance of the young grub it will be seen agrees with what was considered to be the case in the course of the observations made at Messrs. Cranston's nurseries.

The first notes were sent me on the 8th of May, by Messrs. Cranston & Co., from King's Acre, Hereford, accompanying a fine nearly full-grown specimen of the grey variety of the caterpillar, sent as a sample of an infestation on their Apple trees. On the 15th of May they wrote further, and mentioned:—

"We have not discovered it upon our Apple trees until this season, nor has it been found in any considerable quantity, and only here and there have they attacked our young trees. Where they have been found every leaf has been devoured. I send you a few specimen branches which they attacked, and every vestige of leaf eaten. Our fruit-foreman thinks that the grubs are hatched in the autumn, for young caterpillars were found on the bark very early in the spring. We have not applied any remedy for getting rid of them, but simply hand-picked them where found."—(J. C.)

The shoots sent were as described, absolutely cleared of leaves, excepting that in a few instances some small remains of young leafage, in very miserable condition, were still existing, these being almost entirely at the ends of the twigs. For the most part, all had been thoroughly cleared down to a mere stump of even the leaf-stalk. The Apple shoots sent me were from about twelve to seventeen inches long, and of various ages up to young boughs of from three-eighths to half an inch in diameter.

Later on, on the 20th of July, Mr. Cranston further informed me that up to that date they had only discovered two of the moths, which had been observed about the end of June.

PREVENTION AND REMEDIES.—On the Continent of Europe the attack of the Lappet caterpillars is much more destructive than with us, and is recorded as being often injurious there to young Plum trees, also to Pear, Apple, and Peach trees. But even there the mischief is stated to be less from their numbers than from their great size.

In this country probably no treatment is needed beyond what common prudence would suggest. When once attention is directed to the caterpillars being found on twigs of their food-trees in winter, we have the clue towards getting rid of them before they grow to the devastating powers to which they attain in spring. And when they are at work (if by unusual mishap they established themselves) their complete clearance of leafage, if the attack at all resembled in destructiveness that of which I had samples, would draw attention even in its early stages to the locality from which the great grubs could easily be removed.

In most insect attacks the best course is simply to destroy the so-called "pest" in whatever may be the simplest manner; but with such rare and exceptionally large specimens, it may be well to suggest that probably any neighbouring entomologist, or naturalist, might be willing to give some small sum for them, which would (if permitted by the owner) make it worth the while of one of the nursery workmen to collect the caterpillars and dispose of them alive.

Note.—Enquiries or observations were also sent regarding almost all the common Apple attacks, as American blight, Winter Moth, and other moths, Apple-blossom Sawfly, and Apple-blossom Weevil, Red Spider, &c. These were all duly attended to as occasion required, but having been so frequently referred to in previous Reports, it is unnecessary to repeat the details.—E. A. O.

BEANS.

Collier; Bean Aphis. *Aphis rumicis*, Linn.; *A. fabæ*, Kirby & Spence.



APHIS RUMICIS.—1, Bean shoot with Aphides; 2, male Bean Aphid, magnified; 3, nat. size; 4, wingless female, magnified.

Amongst the various kinds of Aphides which were unusually prevalent during the hot and dry season of 1893, the “Black Louse,” or Aphid, of the Beans played its part in various places.

The first note of observation of its presence was sent me on the 6th of June from near Malmesbury, in Wilts, and the last on the 15th of July from the Carse of Stirling, N.B. In this case three stalks of Beans were forwarded to me* for examination as samples of a Bean attack which was then very prevalent where crops of this kind were grown on heavy land.

This kind of Aphid infestation has been so often entered on that it is scarcely worth while to allude to it again, excepting just to record it being present to a troublesome amount in some places. The appearance of Bean plants infested at the upper part, at first with a few black Aphides, as figured above, afterwards with gradually increasing numbers, until the upper part of the stalk is almost one blackened mass of the “Colliers,” their exudations, and the injured pods and leafage, is generally well known, and so also *should be* the simple remedy.

By cutting off the tops early in the attack so far down as the infestation reaches, and carefully destroying these, the further spread of the mischief may be either quite stopped, or greatly checked. This cutting back does no harm as regards lessening the amount or quality of the crop; in fact, rather the other way, if it *is done in good time*. In such case it only removes just a short length of the upper part of the stem which is of very little use, whether with regard to the leafage on it, or to the pods on it, which are usually too small to be of service,

* See my reply in ‘Scottish Farmer’ for July 22nd, p. 567.

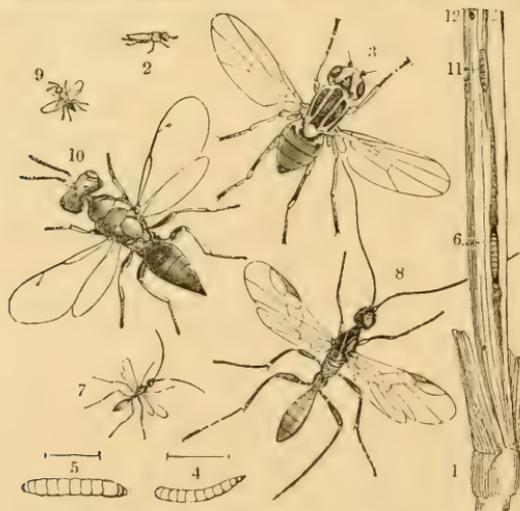
and it throws the sap to the lower pods, which are benefited. If, however, the infestation has been allowed to establish itself, the above treatment would very likely be impossible. In the case of the plants (mentioned p. 5) sent me from the Carse of Stirling, it would only have saved one. The others were too far gone, from the black Aphides having spread down the stem, and also from consequent damage, both to the health and the vigour of the plant.

If the infested part is removed, this and the Aphides on it must be carefully destroyed, or many of these "Colliers" will almost certainly get back to the plants, so that new attack will be started.

In field growth there does not appear to be any remedy excepting nipping off the tops of the shoots; but in garden cultivation, good washings with soft-soap mixtures (or even with water alone), sent as hard at the infested shoots as is safely possible, so as to knock some of the plant lice off, and to clean down the leafage from the stickiness and filth, are sure to do good in this way. Also the watering helps on growth, a very important matter, as Aphides multiply most rapidly on plants which are stunted by drought or other causes.

CORN AND GRASS.

Gout Fly; Ribbon-footed Corn Fly. *Chlorops teniopus* Meigen.



CHLOROPS TENIOPUS.*—Gout Fly, grub and pupa; nat. size and magnified; with infested stem. 7, 8, 9 and 10, Parasite Flies; nat. size and magnified.

* The attack is caused (as mentioned in previous Reports) by the small black and yellow fly, figured above. She lays an egg on the Barley sheath, the maggot from this attacks the ear, and then eats a channel down one side of the stem to the first knot, and then turns to chrysalis state within the leaves.

“Gout” in Barley is now so thoroughly established as one of the attacks which recur regularly to a greater or less extent every year, that it would not be worth while to notice it again save just to record some peculiarities of the infestation in coincidence with the peculiarly dry season of 1893.

The first observation of the attack was at an unusually early date; and afterwards, during the summer, an unusually large proportion of the injured Barley was struck at such an early stage of growth that it failed to grow beyond the condition figured at p. 8. With regard to times of first appearance. Some of the earliest dates of this, of which I have had reports in previous years, were on July 9th, in 1891; on July 6th, 1889; and in the hot summer of 1887, on July 3rd. In the past summer of 1893, the first note of observation of which I am aware was on the 16th of June.

So far as has been shown by the reports sent me in previous seasons, *Chlorops* injury is a trouble of which the amount may certainly be influenced by date of sowing, and last year's observations have confirmed those previously given, that a good state of ground helps to carry infested crop over attack; and have also shown that the amount of damage may be much increased by drought and heat, which act above ground by the air being unfavourable for growth, and below ground by preventing the plant nourishment at the surface of the soil being available to the extent needed.

When under unfavourable circumstances the young Barley is attacked whilst the ear is still only slightly developed within the sheathing-leaves, the effect is most disastrous. The growth of the ear is ruined, and the Barley stalk, instead of running on into straw, is stopped short at a length that may be measured by inches, rather than by feet, with the sheathing-leaves in a swelled and deformed condition, of which the first figure (p. 8), taken from life by myself (see my Thirteenth Report, p. 23), gives a fair idea.

Last season, judging by the specimens sent to myself, there was a very marked presence, at least early in the summer, of this form of attack; and judging also by the observations made in the government leaflet on *Chlorops tenuipus* (the Ribbon-footed Corn Fly), published August, 1893, this peculiar form of injury was that which was mainly sent to the Board of Agriculture, as scarcely any notice is taken of what, in most years, is the most observable form of damage, in which the straw reaches a length moderately useful for farm purposes, and the ear, though injured, still produces enough good corn to make some amount of return.

The second figure (p. 8) of diseased growth shows a specimen of this most commonly observed form of injury, in which, notwithstanding the channel worked-out by the Gout Fly maggot down one side of the stalk as



Plant of Barley diseased by
Gout Fly attack.



H K.—E O.

Stem of Barley showing
blackened maggot-channel.

far as the highest knot, yet the ear has freed itself, and is only materially injured at the lower part. Sometimes the injury from maggot feeding may extend a third or half-way up one side of the fairly grown ear, but if the attack comes whilst the ear is still in embryo, it may extend the whole length.

In the past season the first intimation of bad attack being present that I am aware of, was given in the latter part of June by a short paragraph in several of the agricultural journals to the effect that a serious insect attack of a kind not previously observed was doing much harm to Barley in the crops of Mr. Herbert Dowsett, Park Farm, Pleshey, Essex. The first note of this, bearing date June 16th, was kindly placed in my hands by Mr. E. A. Fitch, of Brick House, near Maldon, to whom it was sent, and was conveyed in the following few words:—"Fifty acres Barley; about one-fourth is affected with maggot (as samples), which eat young ear out. Soil,—clay bottom. Neighbouring farms also affected."—(J. H. M.) The specimen of injured Barley was entirely stunted as figured, and the ear within eaten out nearly throughout its length.

On begging information from Mr. Dowsett as to details, he forwarded me ears of infested Barley, and also ears of sound Barley, standing side by side, for comparison. The injured plants showed very bad attack still in early stage. Some of the plants were stunted as figured opposite, some older, and the chrysalis stage of the maggot was already to some degree reached, for in one instance I found it lying in the upper part of the bristles or awns of the embryo ear. Mr. Dowsett mentioned that he had farmed the same land over thirty years, and had never seen any attack like it before. The Barley was all grown after fallow Mangolds and Swedes, all his own seed corn, which produced last year (1892) over nine quarters, excepting two acres after Swedes, which was sown thin with a sack of Barley bought of — *, at 10/- per bushel. Mr. Dowsett considered that a quarter of his whole crop was spoilt, and that from the bought seed was worse than the crop from his own seed corn.

Specimens of an equally bad, or even worse, attack were sent me on the 11th of July, from the Estate Office, Wendover, Tring, by Mr. Charles T. Adams, with the observation that the Barley affected was taken from a chalky soil. In this case the deformed Indian-corn-like plants, with the still sheathed ears, were sometimes hardly more than three and a half inches in length, from the ground, in the solid part, and only about six to seven inches when the leaves were laid out at full length. One of the attacked ears, when freed from the sheath, measured, when taken together with the stalk down to the uppermost

* Name omitted for obvious reasons.—E. A. O.

knot, only just under an inch and a half in length. In this instance the attack was traceable from the top of the Barley ear down to the first knot; and the little maggot which had caused the mischief dropped from the stem on opening the sheath.

One other report it may be worth while to give as it is accompanied by notes of date of sowing, and of fresh growth from the root after rain. This was sent me on the 17th of August from The Lodge, Massington, Wansford, by Mr. H. Stokes, with the observation:—"I am sending you a few ears of Barley; . . . you will find they have been eaten by an insect from the top down to the knot below the ear, and since the showery weather it has started to grow again from the root." . . . "The Barley is taken from a 24-acre field, and appears to be affected all over; it is after a root crop fed off by sheep, and drilled with the Barley on the 18th, 19th, and 20th of April." These specimens also showed *Chlorops* injury.

In the case of a *Chlorops* attack on Barley, of which specimens were sent me at the end of July, by Mr. Thomas Bunker, of Goole, Yorks, the loss by the attack in the field, from which the insect-blasted ears were sent, was estimated by the farmer to be one-third of the crop.

The following communication with which I was favoured by Mr. J. J. Willis, on the 16th of September, from Harpenden, Herts, is of such important interest relatively to good effect of properly selected manure in lessening effect of infestation, that I offer it with many thanks for the reliable observations:—"You may be interested in the following particulars. During the present season much injury was done in this neighbourhood to the growing crops of Barley by the Gout Fly (*Chlorops taniopus*). The Barley experiments of Sir J. B. Lawes, at Rothamsted, also suffered greatly from the same cause; but it is a fact of much interest that the infestation was considerably worse on those plots which were deficiently manured, while on those plots which were fully manured, that is, received all the necessary constituents for healthy and vigorous plant growth, the injury done was insignificant."

PREVENTION AND REMEDIES.—One very special point of information to be learnt from the past season's observations, is the great degree to which the effect of this kind of attack is influenced by age or condition of the plant, or state of its surroundings. In most kinds of insect attacks it is leaf, or root, or flower, or seed, or it may be attack to the outside of the stem, or inside of the timber; and though infestation may in any of these cases be fatal to hopes of a crop, still there is a good chance of some return. With *Chlorops* attack it is different. This comes on the very centre of growth, and if the plant is still young, it ruins both the ear and the straw. Later on, as the point of deposit of egg is the sheath of the ear, we may save a fair amount of straw,

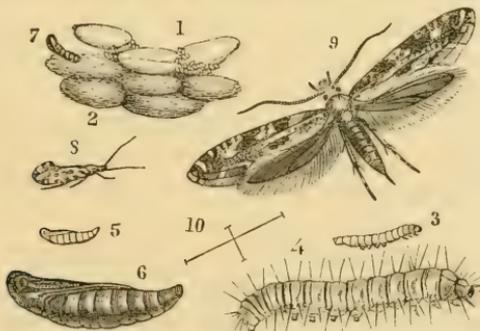
and this and the embryo ear being then grown to a fair size, the infestation cannot do so much harm. The work of a single maggot towards the base of a half developed, or nearly developed ear, and a channel down one side of a fairly grown stem below it, is then very different in effect to that when the length of the whole portion (ear and upper joint together) are scarcely six times as long as the destroying grub. If the reader will note the measure of one of the specimens (one and a half inch) sent me by Mr. Adams, when the ear was freed from the sheath, and compare this length with that of the grub (three-eighths of an inch) figured at p. 6, he will see that this is no exaggeration.

It is of very practical use to bear this in mind, for here we have the key to the benefit of early sowing so well brought forward by Prof. McCracken, at Cirencester, where the March sown Barley was practically free from attack, whilst that sown in May suffered to an extent of not less than twenty per cent. (see my 'Manual,' p. 78), and the same point has been noted by various other observers.

Good growth and a good early start are two things specially wanted to carry on the plant successfully, and though it may be said we cannot command the seasons, still Mr. Willis's note, p. 10, shows that even in the past bad season, and in parallel circumstances of fly being about, the deficiently manured plots were those that suffered most.

This is one of our very worst and most regularly recurring corn crop attacks, and so far as we see at present, agricultural measures are the only reasonable means we have of dealing with it. The winter brood may very likely be in various grasses, &c., and the flies may hibernate here or there; but at present we have not been able to utilize these more theoretical points.

Little Grain Moth or Wolf Moth. *Tinea granella*, Linn.



TINEA GRANELLA.—Little Grain Moth, flying, magnified, lines showing nat. size; moth at rest; caterpillar and chrysalis, nat. size and magnified; infested corn-grains spun together.

In the course of the autumn, Mr. Edward A. Atmore, F.E.S., writing to me from King's Lynn, Norfolk, mentioned the enormous numbers of the *Tinea granella* (popularly known as the Little Grain Moth or Wolf Moth) which had appeared there in the course of the summer. This infestation has long been known as seriously hurtful to stored corn; and its history, and preventive measures regarding this part of the mischief it causes, have been most fully written on by some of our best British and European economic entomologists, from nearly the beginning of the present century up to within two or three years of the present time. In the later of these observations, however, attention has been more fully directed to the extent to which this infestation may be found in natural circumstances in out-of-doors localities, as well as in its artificial and chief head-quarters of stored corn; and in the past season, enquiry was sent to myself as to the nature of attack to the inside of ripe corn-grains still in the ear, which might, I think (if further followed up), prove to be due to the larvæ or caterpillars of this Little Grain Moth.

The note sent me on the 4th of October by Mr. E. A. Atmore, from King's Lynn, was as follows:—" *Tinea granella* simply appeared in swarms in granaries about the town. I have never before seen anything like such numbers of any one species of moth in my experience. When these swarms emerged it was almost impossible for the men to work in the granaries. The stored grain must have suffered from the attack."

Mr. Atmore being an experienced entomological observer, his note of this unexampled appearance is of very practical value, and it may be of use to give some of the main points of this grain infestation for reference, in case it should be remarkably present again in the coming year, and also as a help for observation of maggot attack within grain, before carrying the sheaves.

The *Tinea granella*, or Little Grain Moth, is about half to two-thirds of an inch in spread of the fore wings; these are somewhat narrow, white, and marked with many brown spots, of which characteristically six or seven lie along the fore edge of the wing, three of the largest of these being respectively one at the base of the wing, and two others before and beyond the middle. The fringes are brown varied with white. The hinder wings are also narrow, and are of a mouse or greyish colour with pale grey fringes. The moths may be found from April to August.

In granaries or corn-stores the method of attack is for the moth to lay one or two of her very small yellowish white eggs on a grain of corn. How many she has a capacity for laying is still uncertain. In the words of Dr. Ritzema Bos, "Whilst according to Nordlinger the number only amounts to thirty, Taschenberg speaks of it as being

more than one hundred." After about fourteen days (it may be more or less) the maggots hatch. These make their way into the corn-grains, and there they feed, till, provision falling short, each grub makes its way out again, spins another grain to the one from which it came, and when the contents of this second grain have been devoured it proceeds in like manner to another, so continuing until as many as twenty or thirty grains have been emptied and spun together into a mass, mixed with web and maggot-dirt, as shown at "2" in figure at p. 11.

The caterpillars are sixteen-footed; that is, have three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair at the tail; when full-grown they are rather under half an inch in length; the general colour pale ochrey; the head horny and brownish red, and on the back of the next segment there are dark transverse marks interrupted in the middle.

When these larvæ or maggots are nearly full-grown, they have the habit of not remaining in their feeding quarters, but, leaving the inside of the grains, they pass to and fro, "run about in numbers," as it is expressed, on the surface of the corn, spinning their threads until the whole surface is covered with a thick whitish grey web. When full-grown, which commonly is in August or September, they leave the corn, and betake themselves to any convenient shelter in crannies in the floor, or roof of the granaries, or chinks in the wall. There each caterpillar spins a cocoon of web, or, if circumstances permit, of web mixed with little bits of wood gnawed from its surroundings. Here the larva remains unchanged during the cold weather; it then assumes the chrysalis state, from which the moth may come out, according to circumstances, in March, April, or May.

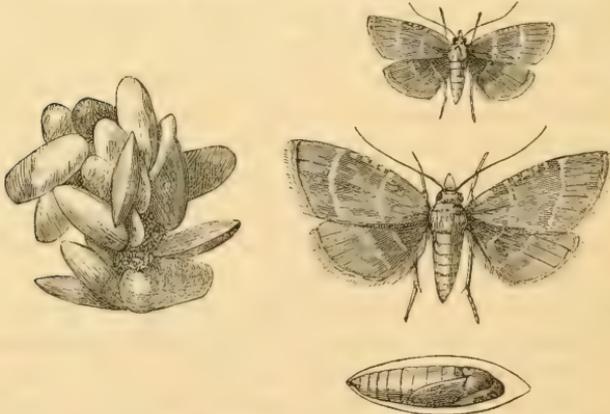
The above gives just a general sketch of the ordinarily recorded life of this infestation in granaries, without reference to possibilities of second broods, or of effects of variations of temperature; and the recorded remedies turn, to a great degree, on the obvious points of preventing, as far as possible, presence of sheltering places for the larval winter rest, by plastering or filling up all nooks in walls and floors, &c., where cocoons could be spun, and similar measures. Also on careful cleaning, whitewashing, scalding, &c., where granaries are, or may be, infested, before putting in new corn. And to these I would add a note, from my own observation, of the effectiveness, in cases of this kind, where steam power is at hand, of turning on a jet of scalding steam or scalding water by a hose from the engine. Where this can be done the effect in destroying maggot or insect presence is excellent. More elaborate operations, as destroying maggots in the corn itself by applying heat which will not injure the corn for use, though destroying its power of germination,—or, on the other hand, of checking maggot

growth by currents of cold air through the heaps of corn,—are detailed at length by various writers, and can be referred to if needed.

But beyond the well-known damage to stored corn, there is what may be happening to ripe corn in the fields, which hitherto has not been investigated as much as might be desirable. Dr. Taschenberg notes of this species, that all kinds of corn are similarly acceptable to it, and that it will on occasion attack other material, as dry fruits or woody fungi. And again, in another passage he notes, after observations on the habits of this *T. granella* in corn stores, that outside, in the open air (or rather in free circumstances), the eggs are in other conditions; they may be laid in the previously mentioned fungi; likewise in grass-seeds, which are always present. It is also noted by Curtis, in 'Farm Insects,' and by Hammerschmidt in Kollar's 'Insects,' that this species of moth deposits its eggs on corn in the field, or in corn in sheaves in the field.*

For lessening danger of this occurring, the obvious plan is suggested of not letting the ripe corn stand uncut longer than is necessary, and also similarly treating the sheaves. It would be of interest to find whether in the coming season, with attention drawn to the subject, it will be observed that damage, in the form of hollowing out contents of ripe corn-grains in the field, occurs to an important extent.

"Hay-stack Moth." *Pyralis glaucinalis*, Linn.



PYRALIS GLAUCINALIS.—Stack Moth, nat. size and magnified; cluster of chrysalis cocoons, giving side and edge view; cocoon opened, showing chrysalis within, magnified.

* Information on this attack will be found in the old standard authorities of Curtis' 'Farm Insects' and Kollar's 'Injurious Insects,' revised by Prof. Westwood; and more recently in the 'Praktische Insekten Kunde' of Dr. E. L. Taschenberg also (bringing the subject up to the recent date of 1891) in the 'Tierische Schädlinge und Nutzlinge' of Dr. J. Ritzema Bos,

The following note of presence of infestation of the little *Pyralis* moth (figured p. 14) in the outer part of some fodder stacks, especially Clover and Saintfoin, near Canterbury, is given, because, though it has not been reported as doing much mischief, yet where the white cocoons of the chrysalis occur to any noticeable amount, a scare sometimes arises as to the quality of the hay being injured.

Whether there is reason for this does not appear, but, in Canada and also in many of the United States,* much harm is at times caused to Clover-hay, which has stood for some years, by infestation of the caterpillar of a very nearly-allied species of *Pyralis* moth, which is sometimes taken here (that is, in England) round stacks, and which is scientifically known as the *Pyralis* or *Asopia costalis*, more popularly as the "Gold-fringe." In America it is popularly known as the Clover-hay Moth or Worm; therefore, as our *P. glaucinalis* appears to be at present without a convenient appellation for common use, I have ventured to suggest the above term of "Hay-stack Moth," as indicating one of its most important localities.

On the 7th of June, Mr. W. Gardner, writing from Bekesbourne, near Canterbury, forwarded me some bunches of the white, flattish-oval cocoons of these moths, spun up with rubbish of the dry material amongst which the caterpillars had fed, and the observation:—"I took them from the outsides of a Saintfoin-stack that has been standing here three years. I never remember to have seen anything of the kind before, and when we cut the stack out, which will I hope be shortly, I shall look and see if it is only on the outside they are very numerous."

The cocoons, of which a good many were successively sent me by Mr. Gardner, were pure white, of a filmy material, like rather flocculent silver paper, and transparent enough to show the shape of the contents when held against the light. The individual cocoons were in shape much like a melon or gourd-seed (see figure), about half an inch in length, rather less than a quarter of an inch in breadth, and rather more than an eighth of an inch in thickness. The two convex sides met, like a melon-seed, at an obtuse edge, and at the extremities were bluntly rounded; one end remained unaltered, the other split open from side to side (to allow the exit of the moth), with such a perfectly straight separation that it seemed doubtful whether this part had been more than just lightly closed. At first the cocoons were very perfect in form, and pure in whiteness; with the escape of the moth they sunk in irregularly.

The contained chrysalids were of a chestnut-brown colour and

* See paper on "Insects Injurious to Clover," by Prof. William Saunders, in Annual Report of the Entomological Society of Ontario, for 1881, p. 45.

about half the width of the cocoon, and one-sixteenth of an inch less in length, and, as far as I saw, lay with the tail extremity either fastened to the inside of one end of the cocoon or quite close to it, the spare space being at the head end. Some of the cocoons lay separately, but for the most part they were spun into clusters by admixture of much caterpillar-web, together with caterpillar-dirt, bits of stick, or leaf, or flower of the material of the stack, and small rubbish generally.

The first moth appeared (out of cocoons sent me) on or about June 7th, and other specimens appeared from small consignments of cocoons sent me by Mr. Gardner for several weeks. These moths (the *Pyralis glaucinalis*) are from a little under to a little over an inch in the spread of the fore wings, which are shiny, and pale grey or grey brown, somewhat browner towards the fore edge (the *costa*), which has a distinctly reddish tinge. Two yellowish lines or slender bands cross the wings transversely from back to front, so as to divide them into three nearly equal portions; and between the extremities of these, at the fore edge of the wing, the reddish colour of the *costa* is very prettily alternated with a few buff spots. The hind wings are also greyish, with two pale cross lines; and round the extremity of each of the four wings, just inside the fringes, there is a faint line, sometimes scarcely observable.

On the 20th of July, that is, about six weeks after Mr. Gardner forwarded me the first specimens, he wrote again concerning this stack infestation:—"I enclose a few more of the odd-looking cases, which appear to me to have some chrysalids in them, which I found around a stack of second-cut Clover growth of 1891. The other stack is now being cut out, and the old 'trusser' says he has seen them before, and they do not go in far from the outside, and (although one hay-merchant who saw them said they would eat the Saintfoin, and he would not have the stack at any price), this old man, who has bought the stack, has made no fuss about it." On the 28th July Mr. Gardner, sending me at my request a further supply of the cocoons, wrote accompanying:—"I have to-day collected the enclosed, which I hope you will find useful. I found them in every one of the stacks, excepting this year's, and even in this year's I started a moth, but they seemed to have preferred the Clover and Saintfoin, as there were very few in the old haystack; they seem to prefer it where it is looser; I suppose it is easier to get further in, and they were apparently more on the N.E. and N.W. sides of the stack."

A little later (on the 10th of August) Mr. Gardner wrote:—"I have been to the stack two or three times since, and find the moths are still coming out, but they do not seem nearly so numerous. They frequent the upper part of the stack more than below I suppose because they find penetration easier; in the old haystack, which is very

close, there are very few indeed, I might almost say *nil*. They put me very much in mind of the clothes' moths, as they seem to run into the stack again as soon as they settle after flying out. They do not appear to go in to any great distance, I should say from six to nine inches, according to the closeness of the stack."—(W. G.)

The above observations of Mr. Gardner show this moth infestation to occur in the outside of various kinds of fodder stacks, as of Clover, Saintfoin, and hay, but to be most prevalent in the material which is most open to ingress, and also in the upper part of the stack, which is the least closely pressed together. The date of successive appearances of the moths ranged over at least nine weeks, probably more, as in the first little packet of cocoons sent me on June 7th there were some containing only empty chrysalids, besides one moth which appeared to have developed during transit; and up to August 10th moths were still observed by Mr. Gardner to be continuing to appear.

As when first the infestation was sent me I was unacquainted with it, I forwarded specimens to Mr. S. L. Mosley, Huddersfield, who gave me the name; and I am also indebted to Mr. Porritt, of Huddersfield, for the observation that "the larva feeds on all kinds of dried vegetable matter, and that he has frequently beaten the moth out of thatch."

In some communication on the subject with Mr. Edward A. Atmore, F.E.S., of King's Lynn, Norfolk, he wrote:—"With regard to the *Pyralis*, it breeds here in accumulated rubbish formed on Birches from the adventitious buds, which produce those peculiar bird's-nest-like formations. I have bred moths from them, but the insect does not seem to be common here."

In an early number of 'The Entomologist's Monthly Magazine,'* there is some very good information by the late William Buckler regarding the appearance of the larvæ of this moth; and also some interesting detailed observations by the Hon. T. de Grey (now Lord Walsingham) on this infestation being found in the masses of deformed twigs often found on Birch trees.†

The larva of the *Pyralis glaucinalis* is thus described by Mr. Wm. Buckler ‡ (see previous reference to Ent. Mo. Mag.):—"At this date" (the 18th of April, 1869) "the youngest larva was about half an inch long, of a dull pale brownish olive green; others were larger and

* See 'Entomologist's Monthly Magazine,' vol. vi (1869—1870), p. 111.

† These masses are sometimes known as Witch-knots, or Witches'-brooms, and are caused by a Gall Mite, or four-legged *Acarus*, one of the Phytoptidæ, nearly allied to the Black Currant Gall Mite, the *Phytoptus ribis*, which causes the swollen growth of buds only too well known to bush fruit-growers.

‡ Mr. W. Buckler's description of the larvæ is given in order to complete the life-history, as I had not the opportunity of observing the insects before they had spun up, and were beginning to emerge in moth condition.

darker, the colour darkening with the growth, until the full-grown larva was almost black.

“When full-grown the length is from $1\frac{1}{12}$ to $1\frac{1}{6}$ inch; the form moderately slender, cylindrical, nearly uniform in bulk throughout, the hinder segments tapering a little at the sides; the region of the spiracles puffed and wrinkled; the segmental divisions deeply cut. The colour of the back is a blackish bronzy green, becoming paler, of an olive or ochreous green tint along the spiracles, and on the belly and legs, the head, and the second and thirteenth segments; the plate on the second segment is margined in front with blackish olive; a fine blackish undulating line, apparently caused by a deep wrinkle, runs along below the spiracles which are inconspicuous, being of the surrounding colour, and merely outlined with blackish; the tubercular dots are a little raised, each bearing a fine hair, the whole surface is shining and bronzy-looking. The first mature larva spun its cocoon on the 23rd of April.”—(W. Buckler.)

The descriptions of the cocoons (so far as given by both the above-named observers) exactly agreed with those from the various kinds of hay or fodder stacks from out of which I developed specimens of the *Pyralis glaucinalis*, and the surroundings of the infestation, whether in stacks, or thatch, or Birch-knots, is much of one kind. That is, dead vegetable matter, passed on in some cases to the next stage of decay, and a point noticed by Mr. Buckler, in his paper above quoted, “of the larvæ being found in the Birch-knots amongst many old cocoons and pupa-cases”; and the observation of Mr. Gardner of the moths hastening back into the shelter of the stack when disturbed, point to the colony when once established remaining continuously, if allowed, in the same spot.

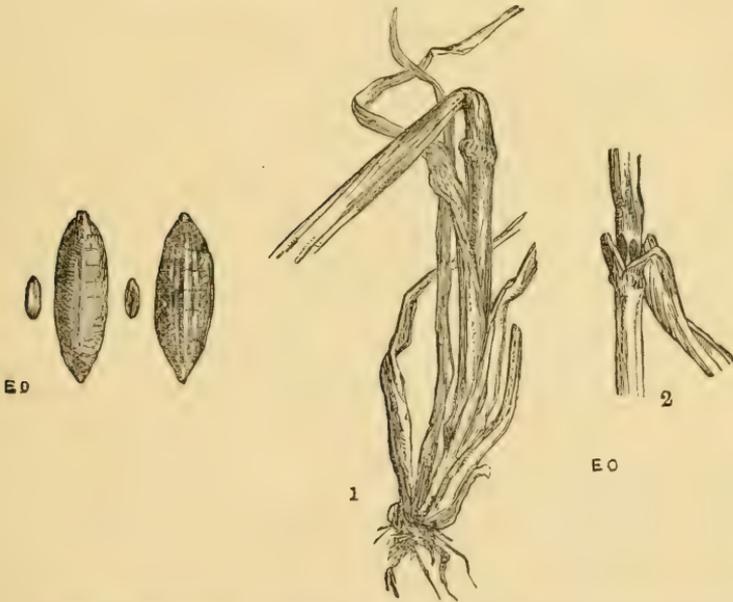
PREVENTION AND REMEDIES.—No complaint of loss from this infestation has been made, though certainly it cannot be desirable to have any appreciable quantity of the hay mixed up with cocoons and old insect rubbish and caterpillar-dirt. But in the case of our nearly-allied British moth the “Gold-fringe” *Pyralis*, which is now widely distributed in North America, the very similar but greater damage caused *there* is well established, and has to be guarded against, and the same method would be serviceable here.

As there it is towards the lower part of the stack that the greatest damage is done, and sometimes “two feet or more of the lower portion has been so full of worms as to be rendered worthless,” it is pointed out that “where Clover is stacked for several years on the same foundation, the bottom layers coming in contact with the infested leavings of the previous year, will be sure to suffer. It is also recom-

mended to put a good log or rail foundation under the stack so as to raise it above the surface.”—(W. S.)

From the various observations of our own *Pyralis*, Stack Moth, it is shown that attack may continue when once established in a suitable locality of dead fodder, sticks, or rubbish; and if the infestation occurs to a troublesome amount it would be desirable, besides clearing out all head-quarters such as may be furnished by rubbish beneath the stack, to give attention to similar neighbouring surroundings. Caterpillars that feed amongst masses of old Birch twigs, or in thatch, as well as in old stacks of Clover, hay, or Saintfoin, cannot be very exclusive in their diet, and by care in search, and also in destroying all spoil outside of the stacks which might prove to be infested when opened, we might save all further attack.

Hessian Fly. *Cecidomyia destructor*, Say.



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

Hessian Fly attack appeared in some localities in the past year; but, personally, I had so very few applications on the subject, that altogether these can hardly have amounted to a dozen notices at the very outside. Also a few apparently reliable accounts of presence of this infestation in various districts appeared in various of our agricultural

journals; but I cannot myself see any cause for great anxiety on this matter any more than with regard to others of our ordinary corn insect pests. Last year being a hot season, especially favourable to its prevalence, it was to be presumed it would be present; but so far as I am aware, this was not to anything like the extent to which it was reported in the hot season of 1887. In that year, the second of its recorded presence as a Wheat and Barley stem pest with us, it was reported (with specimens accompanying, or by contributors well conversant with the attack) from more than seventy-two localities in England, and about twenty in Scotland, these centres often representing districts, and sometimes many miles of area of attack; as for instance, in the north of Scotland, whence on the 29th of August, Mr. John Milne, of Inverurie, Aberdeenshire, wrote me (with specimens accompanying) that traces of the insect could be found in every field along the coast from Aberdeen to Cromarty, and inland for twenty-five to thirty miles.

Yet, notwithstanding this widespread prevalence in 1887, in the following year I only received about six reports of presence, and of these only one mentioned the attack as being prevalent in that district; and last year attack generally seemed hardly worth alluding to.

The infestation may commonly be known by the attacked Barley or Wheat straw elbowing down (as figured at p. 19) just above one of the lower knots in the stem, consequently on this part being weakened by the continuous feeding of the little maggot of the brown gnat midge, known as the Hessian Fly. Attack may be higher, or it may be lower, even at ground-level. Where it is may be known on examination by the presence of the little flat brown chrysalids known as flax-seeds, figured p. 19 at "2."

It is a most unlikely thing that this infestation will ever take hold here with our insular and changeable climate, as it does in Continental countries, where a recurrence of weather suitable to its propagation may come more or less yearly as a matter of course; and it is to be regretted that from some cause or other a popular and exaggerated interest has become attached to the very mention of "Hessian Fly"! I fully believe that, excepting Corn Sawfly, we have no corn attack which it so fully lies in our power to check increase of; or I should better say, no corn attack which can be so demonstrably, and even arithmetically, proved to lie so fully in our power to check much of the increase of.

On each farm where there has been Hessian Fly attack, we find at thrashing time the chrysalids gathered up, without extra cost or trouble, in the light screenings. If these are destroyed in any convenient way there is an end of all increase from these.

If, on the other hand, these flax-seeds are only flung aside from

neglect, or saved for any reason whatsoever, it is a certain thing that, weather and circumstances permitting, the Hessian Flies from them will attack next year's crop; if destroyed there will be no further trouble from them.

Where circumstances do not allow the winter crop (as after infested Barley) to be ploughed in, or otherwise treated, so as to destroy the flax-seeds fallen from the stem, we have no apparent remedy, and we must in this case hope that the "parasites," which are so frequently brought under our notice, and which really do good in destroying the pest when we are not able to do it (as above mentioned) much more surely ourselves, will play their part rightly.

Where flax-seeds have fallen, as many must, amongst the stubble of the reaped cornfields where the plough is to be put in, the matter, if requiring attention at all, can be met to some extent by treatment. Deep ploughing, or ploughing with skim coulter, so as to turn the flax-seeds thoroughly down where they will not be brought up again by subsequent agricultural arrangements, will quite certainly be useful.

Also burning the stubble is a well proved remedy, and would get rid of many kinds of insect pests besides the one under consideration. In most seasons this operation is neither very easily practicable nor much needed, but last season (1893), when the exceptional heat and drought would have allowed the firing, it would have cleared out the ground remains of attack excellently. The right method of operation is first to burn a narrow band of stubble all round the field, this effectually keeps the fire in the circumscribed area, and ensures safety to hedges. In the opportunity of observation given by railway journey, I have noticed fields and strips of fields safely fired, and the benefit in clearing pests that we can get at no other way is great.

But in our island we have great security from prevalence of serious widespread attack, in our climate, and so far as Wheat is concerned in our customary date of sowing, bringing up the autumn Wheat after the time of the autumn brood of Hessian Flies having died off; and if in the coming season we have ordinary climatal conditions, it may reasonably be hoped that widespread mischief will be as little present with us from this pest as in the years after the hot season of 1887 to the hot season of 1893, when though bad in some localities, it could not be described as a general trouble.

Whilst the above note on Hessian Fly was passing through the press, I was favoured by Mr. W. M. Schöyen, Conservator and Government Entomologist at the Zoological Museum, University, Christiania, with the following observation of the first recorded appearance of this pest, the *Cecidomyia destructor*, in Norway. With the notes of locality, &c., given below, Mr. Schöyen also placed in my hands a few specimens of Barley

stems with the puparia of the Hessian Fly, commonly known in this country as flax-seeds, still adhering to the stem beneath the sheathing-leaves.

Mr. Schöyen's communication, sent from the Zool. Mus., Univ., Christiania, on the 19th of Oct., was as follows:—"I hope that it will be of some interest for you to know that the 'Hessian Fly' (*Cecidomyia destructor*) is now, for the first time, observed here in Norway doing damage upon Barley. I send you herewith some small bits of Barley stems with the 'flax-seeds,' or puparia, of this insect that you may ascertain the fact. As I am told, the damage on the concerned locality, Ringerike, was last year much greater than this summer, at least one-quarter of all the Barley stems having then been 'elbowed' down by the insect; but then I knew nothing of the matter. Having been informed this summer of the presence of some noxious insect in the Barley stems on the named locality, I visited the place in the middle of August, and found some of the maggots and puparia of the Hessian Fly between the sheaths and stems of the damaged Barley plants. It is thus made evident that this noxious insect is now introduced even to our country, probably with foreign seed corn; though I hope this insect will not prove so fatal to us as in more southern countries. Preliminarily I have recommended the burning of the infested screenings and fall-ploughing of the land instantly after harvesting."—(W. M. S.)

Under the careful attention which is being given, there is good hope of the recurrence of the infestation to a severe extent being well held in check.

Rose Chafer; May-bug. *Phyllopertha horticola*, Linn.; *Anisoplia horticola*, Curtis. **Common Cockchafer.** *Melolontha vulgaris*, Fab.*



PHYLLOPERTHA HORTICOLA.—Rose Chafer, nat. size (walking), magnified (flying); grub, also magnified.

* A few notes having been sent of presence of Cockchafer grubs at a locality also infested by those of Rose Chafer, the observation is added in the following paper.

Rose Chafers have caused serious mischief in a good many localities during the past season. As a common thing (that is, in ordinary seasons and excepting under very special circumstances, or just here and there) no great attention is paid to the pretty brown and green beetles which, however destructive to Roses for a while, pass away presently, and unless they have extended their ravages to leafage, or much more widely than is customary, are little more thought of. Also they are known, but by few, to be the parents of the grubs, like little Cockchafer grubs, that presently ruin the adjacent lawns and meadows by preying on the roots of the Grass. Last season, however, Rose Chafer presence, both in beetle and maggot state, was too great, and too marked, to escape observation, and the notes contributed may help to a better understanding of the nature of the attack.

Amongst points which have been especially noticed in the following observations are,—firstly, the continuance of this Rose Chafer infestation for year after year in one locality when thoroughly established. Secondly, that when the swarms of these pretty brown and green Chafers appear at their work of destruction, whether on Roses or elsewhere, unless means are taken to destroy them, their disappearance in the natural course of things will be followed by an autumn appearance of grubs (see figure, p. 22) in Grass-fields, lawns, and the like places, which may prove possibly only disfiguring from the patchy condition of the field where Grass has died from attack at the root, or possibly may be on a scale making new laying down of the field requisite. Where grubs are in the numbers named at page 25, of twenty-one grubs or somewhat more to a foot square of ground, this would be somewhere about one grub to every two and a half inches of Grass roots, and the results are necessarily serious. Thirdly, that whilst the beetles are on Roses or leafage from which they can be shaken down, a great deal may be done to get rid of the infestation surely, cheaply, and easily; but when the grubs are at work at the roots of the Grass, I should certainly say myself, judging by what information I can gather, that to destroy them without greatly injuring or destroying the Grass is a matter well nigh impossible, even with the assistance of the flocks of different kinds of birds, which do their best to aid us in clearing the pests.

One of the first notices which I received during the past season of the Rose Chafers being observable in great numbers, was sent me on the 23rd of May, from Foxbury, near Sevenoaks, Kent, with specimens accompanying, by Miss Matthews, who wrote as follows:—"I am desired by my brother to forward to you a few specimens of an insect which has been found here in immense numbers during the summer months of the last two years, and is now on the lawns, meadows, and fruit plantations of his property in greater numbers than before. The

insects devour Roses, but so far we have not *noticed* that they eat other leaves. They swarm out in the sunshine, but disappear within the cups of flowers, or holes in the Grass, directly the sun is obscured, or the weather becomes dull and cool. My brother is a grower of Hops, Nuts, Plums, and Currants; and the soil being very sandy and poor, a very liberal use of manures is necessary for their successful cultivation."

The specimens sent me were of the little bright brown and green Rose Chafers, the *Phyllopertha horticola*. These I found to be wonderfully active in the earlier part of the day. In the evening they were quiet and torpid, but when set on the window-sill, they roused up and walked to the edge, and then (with one exception) spread their wings and flew strongly away.

The infestation was exceedingly prevalent near Haslemere, in Surrey; and the following note, with which I was favoured by Mr. Charles Pratt, of Marley, near Shottermill, Haslemere, gives a very good observation of it in that locality:—"The Chafer which has been so destructive in my pastures and lawns, and other crops, is the bright copper-coloured creature, with blue-green head, called (Mr. Buckton tells me) *Phyllopertha horticola*. It did not attack the corn crops, but infested Roses and many garden things. The grubs have eaten the roots of the Grass which has decayed, and on being pulled comes off in large patches. Thousands of starlings are at work in the pasture fields pulling up the dead Grass, and turning it off to get at the fat succulent grubs, and the thrushes are doing the same good work upon the lawns." . . . "What I propose to do is this: to harrow up with a long spiked implement all the decayed turf, and leave the Grass exposed to the further attention of the birds for a week or two. Then sow renovating seeds over the bare places, covered with freshly dug sand (my natural soil), and well roll it. The autumn rains will, I hope, bring up the seeds before the frost sets in. Then I shall apply a heavy dressing of lime all over, and leave it till the spring, at which season, if it looks promising, I shall give a top-dressing of artificial manure (of a sort to be decided upon), and trust to getting a little Grass for next year's hay and pasturage."

In a second letter on the subject, written by Mr. Chas. Pratt, on Sept. 22nd, he mentioned:—"For the thirty years during which I have had experience with land, I have had no knowledge of any insect pest so destructive as this *Phyllopertha* Chafer. But I live on a sandy hill, and I never knew such a drought before!" . . . "I stated that it had not infested my cornfields; but the result of more complete investigation to-day convinces me that my statement was premature. The grubs are found in a lively condition about eight inches below the surface in the corn stubbles. I doubt now whether any remedy will

extirpate them that can be economically applied." . . . "I have a number of chickens and guinea fowls feasting on the grubs, and I shall turn out a few pigs, as you suggest, and see what they will do. But I find that these grubs can go down very deep in my light soil. I am sending you a box containing some of the grubs, packed in a small piece of the destroyed pasture in which they were found, and it will give you some idea of the number of them when I state that all that are contained in this little box were found near the surface on a space one foot square." (These amounted to upwards of twenty-one grubs.—E. A. O.)

For the following note of great presence of the Rose Chafers having occurred for a few days, and of the simple method used to get rid of them, I am indebted to Mr. T. P. Newman, of Hazelhurst, Haslemere. Writing on the 20th of September, Mr. Newman mentioned:—"They swarmed with me for two or three days only; we did nothing by day, but acted on your hint at dusk; put sheets under the fruit trees, shook the latter, and picked up hundreds of the beetles, which made no attempt to escape, and destroyed them in hot water. They attack the Scotch and Austrian briars much more than any other Roses."

Specimens of the same kind of Chafer grub, and at the same stage of growth as those which were then being forwarded from various localities as doing great mischief to Grass where the Rose Chafers had appeared earlier in the season, were sent me on the 28th of September by Mr. C. R. Longbourne, of Ripsley, Liphook, Hants. Amongst various points of interest it will be seen that date is given of the first observation of damage being established to an amount sufficient to attract birds to the grubs in the injured turf.

Mr. Longbourne mentioned:—"At the suggestion of my neighbour, Mr. Newman, I am forwarding in a small box some specimens of grubs taken from the meadow near my house; it is suggested that they are the product of the small brown beetle which appears yearly on our lawns and fields in the month of June, and which this summer swarmed in unusual quantities. The grubs this season have done considerable damage to some fields and lawns in this neighbourhood. They eat the roots of the Grass, which therefore withers and comes away in patches when touched. Large flocks of starlings, numbering several hundreds in a flock, frequent the fields where these grubs abound, and the soil is perforated by the birds' beaks. In the field in front of my house my fowls are constantly hunting after the grubs, and, by their scratching, they have made large patches of it look like a ploughed field, the Grass plant coming away in tufts, as before mentioned. I should state that our soil is a poor sand, and that, in the fields in question, the plant of Grass is very inferior. P.S.—Judging from the work of my fowls, I should say the grubs first appeared near the surface about the middle

of August, but it was not until the 2nd of September that my gardener brought me some specimens to show me the cause of the havoc wrought by the fowls, and of which I had been complaining."

On Oct. 12th. Mr. Longbourne further wrote:—"I have seen less of the grubs since the recent rains, and they have probably gone down deeper into the soil."

Maresfield Park, near Uckfield, in Sussex, was another of the localities at which the presence of the beetle in great numbers early in the season was followed by presence of the grubs beneath the turf in autumn. On May 25th, Mr. Mark Sandford, writing from the Estate Office, Maresfield Park, remarked:—"This year we have a plague of beetles, some enclosed herewith" (these proved to be specimens of the Rose Chafer, the *Phyllopertha horticola*); "they eat up our Roses, and are in shoals on the Grass of the Park here."

On Oct. 2nd, Mr. Sandford, in reply to my enquiry whether the beetle larva were to be found in the ground on which the Rose Chafers had been noticeable, further mentioned:—"We have just been searching in the turf in the park at places where the turf is dug up by the rooks, and find grubs which I think you want. I have often wondered what the rooks were searching for, and now I suppose we know; I send you some by this post. For years we have found the rooks doing this, generally in one portion of the park. The bailiff searched other places not touched by the rooks, and could find no grubs."

Another communication, also showing the prevalence of the infestation in the neighbourhood of Haslemere, was sent me on the 19th of September, from Longdene, by Mr. Wm. Jackson, as just a short note pending possible fuller observations:—"At present we only suffer from a slight disfigurement of our lawns, and from an uneasy feeling that the worst is yet to follow, and is unknown. The birds are doing good service in removing the grubs, but they do not do so very tidily."

Near Rickmansworth (through favour of a friend), I heard of severe presence of this same infestation at Grass roots in one locality, the ground being exceedingly infested with the grubs, of which samples were sent me, notwithstanding crowds of birds of all kinds which were to be seen greedily feeding all day.

Other observations, which were of unusual interest, inasmuch as they referred to presence of the same kind of grubs as those previously mentioned a little below the surface, and the grubs of the Cockchafer (the *Melolontha vulgaris*) deeper down, were sent me from Detmore, near Cheltenham, by Miss Dobell.

The first of these was sent me on the 4th of September, and noted that on the previous day, September 3rd, one of their fields of six acres was observed to be infested in large patches by Cockchafer grubs. These were in colonies under the Grass, which was dying off, and in

places had been much torn up by the fowls during the previous day or two, and thus attention was called to the state of things. The fowls were stated to be doing their best, but their plan of operation to be so destructive, that a remedy was desired which might be equally effectual without ruining the pasture.

A few days later, Miss Dobell further wrote :—“ Before your letter came I had set some men and boys to work to gather them, and we have had thousands, and still have more to do. You can put your hand under the Grass and lift the Grass off, and wherever you can do this there are the grubs. We are burning the Grass as we take it off, as even in this short time (since haymaking) the Grass has died too much to be worth planting.”

Specimens of the grubs which were forwarded to me showed that some which were dug up about a spade depth were certainly Cockchafer grubs (scientifically, larvæ of the *Melolontha vulgaris*) ; others taken from immediately below the Grass appeared in no way to differ from the grubs of the Rose Chafer.



MELOLONTHA VULGARIS.—Common Cockchafer, larva, and chrysalis.

On the 27th of September, Miss Dobell further mentioned :—“ In all the places where we have not picked the grubs, they still remain just below the Grass. I thought the three frosts we have had might kill them, or send them deeper, but it has not. We have left off taking them, and left the birds and chickens to do what they can ; but though they have been hard at it, I am sorry to find they leave many behind where they have been.” And two days after, on the 29th, the grubs were as active as ever, or more so. The length of the Rose Chafer grubs when extended, which I had not previously measured, was now

a little under three-quarters of an inch; and Miss Dobell noted,—“Now the rain has come they seem very active, and the birds too; our field is at times black with starlings and missel thrushes.”

The mischief caused by the feeding of the Rose Chafer grubs beneath the turf continued certainly up to the middle, and on as late as the 17th of October, and presumably, weather permitting, much later.

On the 14th of October, Mr. T. P. Newman, who was good enough at my request to make special search as to whether the grubs were still to be found, wrote me from Hazelhurst, Haslemere, Surrey, as follows:—“I am sending you the result of two diggings, one a space of about 24×12 inches, the other about 14×12 inches. The top three inches contains no grubs at all. Between three inches and six there are few. Below six inches and down to nine inches they are plentiful. Below nine inches down to twelve there are few. Below twelve inches there is little but stone and shale, and there are no grubs.”—(T. P. N.) These notes of depth of chief amount of grub presence seem to me of very practical interest regarding remedial measures noticed further on.

On the 17th of October, Mr. Mark Sandford, writing from the Estate Office, Maresfield Park, Uckfield, added the following note of destruction then going on to his previous observations:—“The rooks are very busy in the park each early morning, almost ploughing up the turf for the grubs of the Rose Beetles; no doubt they seem to be damaging the turf very much, but I presume it is the best way to get rid of the beetles, is it not? They seem to know exactly where to find them, as they do not go all over the park, only at certain places, and at those places we can find the grubs, and not elsewhere.”

The beetles are easily recognizable by being of the shape and size figured at p. 22, the colour of the head and fore body bright deep green, the wing-cases bright brown. The wings are ample, the under side of the body and legs black. The life-time of this Rose Chafer (*Phyllopertha horticola*) is now known to extend in all its conditions only over twelve months. The beetles, as we know, appear in May, or early in the summer, and feed very especially on Roses, but also on many kinds of leafage. The female beetles then deposit their eggs (up, it is stated, to the number of a hundred) in the earth, and then they die; the grubs from these ravage, as we know, at plant roots, especially Grass roots, and by November are full-sized. During winter they lie in the ground, and presently change to the pupal state, from which the beetles may be expected to develop in May.

The life-history of the Cockchafer, the *Melolontha vulgaris*, is very similar to the above in the main points,—with the exception that the Cockchafer (as shown at page 27) is upwards of four times as large

as the *P. horticola*; also it is much longer lived, as it passes four years before it reaches beetle state; and also its flight time is in the evening, not in the sunny hours of the day.

The grubs in both cases are very fleshy, yellowish in general colour, excepting at the extremity of the abdomen, which is more or less swelled out by the contained food into what is called the "sack," which, from this food showing through the transparent skin, has a dark bluish colour. Both kinds have horny brownish or ochrey heads, armed with strong jaws, and also both kinds have six long legs at the fore part of the body. There is no difficulty at all in distinguishing between the kind of the grubs after the Cockchafer grub has passed the full-grown size of the Rose Chafer grub; but previously to that, it appears to me there may be difficulties in technical identification.

For those, however, who wish to be able to identify the two kinds of larvæ with certainty for scientific purposes, the fullest descriptions are available in the work 'De Metamorphosi Eleutheratorum Observationes,' by I. Schiodte, which extend over two or three pages each of Latin descriptions. Not being able myself fully to master the details of the entomological Latin, I most gladly availed myself of the kind assistance of Mr. W. Hatchett Jackson, M.A., of Keble College, Oxford, who was good enough to translate and tabulate the distinctive points for me. The attack was passing away when I became aware of these full descriptions being in existence, and specimens in spirit were not serviceable for certain identification of many of the minute details; but so far as I could judge from the more obvious characteristics besides those which I had observed during the summer; and also that of the power of the grubs of moving about with very fair activity, also their decided difference in appearance from that of a half-grown Cockchafer grub, which I had the opportunity of examining, it appears to me that all the different collections of grubs sent from under the turf (save where otherwise specified) might be safely considered to be those of the Rose Chafer, the *Phyllopertha horticola*.

The following notes of some of the characteristic differences between the two species of larvæ (taken from the work above mentioned), which do not require either high microscopic powers, or minute dissection for their observation, may perhaps be of service.

Larva of Phyllopertha horticola.—Vertical suture of head a very fine line. Epistoma broader by half than it is long. Third joint of antennæ of same length as the first joint. Tibiæ of legs twice as short as femora. Claws of legs increasing in size in the successive pairs. Abdomen cylindrical though somewhat clavate. Anal valves obscurely marked off; lunate in shape. Spiracles orbicular.

Larva of Melolontha vulgaris.—Vertical suture of head deeply countersunk for a short space behind the epistoma, its margins some-

what raised. Epistoma three times as broad as long. Third joint of antennæ nearly one-third shorter than first joint. Tibiæ of legs one-fourth shorter than femora. Claws of legs diminishing very greatly in size in successive pairs, most markedly and abruptly in those of third pair. Abdomen clavate. Anal valves sharply marked off; upper valve triangular, lower valve trilobed. Anterior spiracles short ovate, posterior orbicular.

PREVENTION AND REMEDIES.—So far as appears at present the only really reliable remedy for Rose Chafer attack is shaking or beating down the beetles (see p. 25) in the evening, or early morning, when they are torpid from weather effects, or other causes. If they are shaken down when they are not disposed to fly (as at dusk, in the evening, or in the cool morning hours), they may be destroyed in great numbers. This may be done by hand-picking the fallen Chafers, and scalding them, or they may be gathered off cloths, or sheets of any kind, which have been laid beneath the infested trees before shaking the beetles down, and these collections thrown into scalding water, or into any mixture which will kill them. Where they have to be destroyed on a large scale (similarly to Cockchafer beetles), it may answer to have pigs ready to devour them. But it is important in both cases to be sure to take the time when the beetle is quiet, for with the Cockchafer the dusk hours are its special flight time. Clearing the beetles in this way necessarily lessens the amount which would otherwise lay eggs in the Grass fields, or lawns, or other localities suitable for the purpose.

When the second stage of the attack is doing damage in the form of the maggots feeding at the roots of Grass, then the chief practicable remedy appears to be to take care that the flocks of birds, which tear up the surface of the lawns or Grass lands to get at the grubs, should not be disturbed at their work. It will be seen in the preceding pages that the starlings are particularly useful in clearing the grubs; they are mentioned as coming "in large flocks"; "in thousands"; and also the ground being "black with starlings and missel thrushes." Rooks also are noticed as doing good service in digging up the grubs; and in another observation, a note is given of "birds of all kinds feeding greedily all day." Poultry also of various kinds aided in clearing. Whether turning pigs (not too much rung in the nose) on to the infested ground might not be a still better way of getting the maggots destroyed, is open to doubt; but the more complete ruin of the turf by the ploughing up of their noses than even what is caused by the tearing of the birds, makes the plan objected to.

The depth at which the grubs lie beneath the ground makes it exceedingly difficult to deal with them by applications of surface

dressings; but where they lie sufficiently in reach, the following suggestions by John Curtis, or a modification of them, may be of use.* “To kill these larvæ, water the Grass in the autumn with one-tenth gas liquor to two-tenths water; it will do no mischief to the Grass, but will extirpate the miners. Where the gas liquor cannot be employed, employ strong salt and water.” These prescriptions would need some care in carrying out, and experiment as to strength of application safe to use, or they might only complete the mischief. There is, however, very likely to be this benefit gained by their *careful* application, that even if they did not kill the grubs, they would make the earth so disagreeable to them, that the grubs would go lower down, and do less mischief whilst the effect lasted.

Potash, unslaked lime, and other alkalis, are stated to be useful to strew over infested land before or after the winter season, and gypsum also is mentioned as desirable; but looking at the depth at which they have been recorded as at work in the previous observations, and that to which they can or do go down in winter, which is given, even in November when frost has set in, as much as a spade’s depth, it may be doubted whether these applications would do more than help to restore the Grass growth. There is also the point to be considered that the strong smelling or tasted applications, like gas water, might drive off bird help.

After examination of the various kinds of treatment advised for the last fifty years or more for the extirpation of these pests, it still does not appear to me that anything can be surely relied on, excepting shaking down the beetles and destroying them.

* See ‘Gardeners’ Chronicle’ for Oct. 19th, 1844, p. 700.

GOOSEBERRY.

Gooseberry and Ivy Red Spider. *Bryobia pratiosa*, C. L. Koch.



BRYOBIA PRÆTIOSA, from life; *B. SPECIOSA* (outline figure after Koch); both magnified. Leaf infested by "Red Spider," nat. size.

During the past spring and early summer, Gooseberry leafage was infested to a very unusual extent by a small *Acarus*, or "Mite," commonly known as "Red Spider." This Mite is of a different species to the well-known "Red Spider" of the Hop, and is very commonly to be found on Ivy leaves; but in the past season, without apparently being less present on Ivy, it extended its infestation to Gooseberry leafage to an amount causing serious loss to growers in many localities.

The first report of the mischief that was going forward was sent me on the 15th of March from Great Eversden, near Cambridge, by Mr. Francis Nixon, and from that time until the 21st of June enquiries were sent as to the best means for checking the evil. Letters regarding this prevalence of Red Spider were sent from localities over a large area of country; it was reported from near Rochester and Brighton, and other places in Kent, and Sussex, and near Lymington, in Hants. In Hertfordshire I had it in my own garden, and it was also present at Watford. Special observations of the presence of the Mite as a most destructive pest were sent from various places in Cambridgeshire; notably from near Wisbech, Histon, Meldreath, and Great Eversden, near Cambridge, and from grounds of growers up to an extent of three hundred acres. More westerly, it was noticed as troublesome at Pershore, and also at Evesham, in Worcestershire; it was also reported

to me as present in great quantities near Cirencester, by Prof. Allen Harker, of the Royal Agricultural College; and, passing on to the most northerly locality reported from, it was present to a very noticeable amount up to the early days of June in the neighbourhood of Perth.

Not being sufficiently well acquainted with the *Acarina* to be able to identify these Mites trustworthily myself, I applied for help in the matter to the well-skilled determination of Mr. Albert Michael, F.L.S., who kindly examined the specimens for me, and sent me, on the 11th of May, the following reply:—"They belong to the genus *Bryobia*, and are the *Bryobia pratiosa* of C. L. Koch, but I very much doubt this species being different from the *Bryobia speciosa* of the same author; you might really call them by either name; but this variety is Koch's '*pratiosa*.' The creature swarms in millions on Ivy in gardens at this time of the year. I do not think that it usually does very much harm to garden produce, as it prefers the Ivy, but sometimes it does a good deal of damage. If there be Ivy in the garden it comes from, the owner may probably get rid of the Mites at the expense of the Ivy; if he does not do this, the evil is likely to be recurring. You will find that Andrew Murray and Koch class *Bryobia* among the Trombidiidæ, but this is an error; clearly its nearest ally is *Tetranychus*, the common Red Spider."—(A. D. M.)*

At the heading of this paper a magnified figure is given of *B. pratiosa* (taken from life last season), together with a copy of Koch's outline figure of the *B. speciosa*. These give the general form, and especially the great length of the front pair of legs, which is a characteristic of the *Bryobia* (Koch). The size is difficult to state for general purposes, but amongst the specimens I examined, the thirty-second of an inch, that is, the quarter of the eighth of an inch, would give a fair idea of the average length. With regard to colour,—amongst the first specimens which were sent me on the 17th of March, from Great Eversden, by Mr. Francis Nixon, the larger number were brick-red of various shades from bright to ordinary brick colour, and some much deeper and duller in tint. These were in some instances moving about

* In Murray's '*Aptera*' a short description of the main characteristics of the genus *Bryobia* will be found at p. 117, followed by a figure of *B. speciosa*, after Koch, in which one peculiarly distinguishing point of the margin of the abdomen being set round with short papillæ is indicated. In a paper on "The Clover Mite" (another species of *Bryobia*, namely, *B. pratensis*), by Prof. C. V. Riley and C. L. Marriatt, given in No. 2 of Vol. iii. of '*Insect Life*' (Washington), observations will also be found regarding this belonging to the family of vegetable-feeding Mites, the Tetranychidæ. These points are desirable to bear in mind now that they have been clearly defined, to prevent the errors on the one hand of placing this little Mite in a separate division from its nearest allies, and on the other of mistaking it for the only too prevalent Red Spider of the Hop and of other plants.—ED.

quite actively on the leafage of the Gooseberry twigs sent, which were about four or five inches long, with the leafage well forward, and a little of the blossom bud showing.

About a month later (amongst specimens sent me from Pitfour Castle, Perth, N.B., by Sir J. Stewart Richardson, Bart.), I found the same kind of "Red Spiders" in great numbers, some bright red and active, and others congregated in the axils of the veins of the leaves close to the origin of the leaf from the leafstalk. This appeared to be a favourite position, and these little parties of Mites were mostly of a darker, or partially of a darker, tint, being in some cases vermilion along the centre of the back of the abdomen, and dark towards the sides (see magnified figure, p. 32). This figure also shows the full number, that is to say, eight legs of the adult Mite; when hatched it has only six.* The web, which is so noticeable under a fair magnifying power in the case of the Hop Red Spider, was very little observable in the early stages of infestation, even where I made special examination with a quarter-inch power; I think I made out that there was a little, but I could not feel certain.

The following are some of the reports of observation sent in the past season. On the 15th of March, Mr. F. Nixon, writing from Great Eversden, near Cambridge, remarked, "It might interest you to know that at this early stage the Gooseberry bushes in this neighbourhood are already covered with 'Red Spider'"; . . . "all have it more or less."

On the 23rd of May, Mr. Nixon, who had been frequently communicating on the subject of the Gooseberry Red Spider presence since his first observation of March 15th, wrote that he had seen hundreds of acres looking ruined by this troublesome pest, and remarked:—"I have been into every fruit-growing district in Cambridgeshire, and everywhere it is the same. Not a single plantation have I found entirely free from it, whilst the ravages in most have been terrible."

Reverting to order of date of appearance: on the 27th of March, Mr. Chas. Whitaker, of Caldewell, Pershore, Worcestershire, applied for information as to remedy for Red Spider on Gooseberry bushes.

On the 27th of April, Prof. Harker, of the Royal Agricultural College, Cirencester, wrote me from Oakley Villas, Cirencester, as follows:—"I dare say this long dry season has put you on the alert for

* In the paper by Prof. Riley, previously quoted at p. 33, will be found first-rate and very highly magnified figures of *Bryobia pratensis* in adult, and also in young condition, which may be serviceably consulted for differences of structure at different ages. In the case of this "Clover Red Spider" it is noted (pp. 47, &c.) that the eggs are blood-red, and have been found in great numbers during winter on the bark, or under loose bark, of various trees, together with some amount of hibernating Mites.

some special developments of insect and other pest life. To-day my boy and I found an amazing phenomenon on the leaves of the wall Ivy, on all the roads and gardens around here. Thousands, millions, of Spinning Mites! One leaf, not very big, had over one hundred specimens, and every leaf for almost acres had some." . . . "I think I never saw such an army of living things."

Later on, Prof. Harker kindly sent me the following additional note relatively to observation of web spun on the infested leafage, which, whilst the attack was only just beginning, I had scarcely been able to find, even doubtfully, and usually not at all, on the sample leaves forwarded to me.

Prof. Harker wrote me:—"After some weeks the enormous numbers of Mites gradually diminished; but they left behind them what had not at first been visible, their common webs, covering the whole of the Ivy for quite one or two hundred yards, from the ground to the top of the six feet wall, and as these webs caught the dust and wind-borne débris of the roadsides they became thick and matted, and quite disfigured the whole Ivy. Up to middle of August a few of the Mites were still occasionally found."—(A. H.)

About the same date as the first of Prof. Harker's observations, given above, that is, on the 17th and on the 29th of April, Sir J. Stewart Richardson wrote to me from Pitfour Castle, Perth, N.B., regarding the appearance of this infestation on Gooseberry bushes, and afterwards also in great numbers on Ivy. On the 17th of April, Sir J. Stewart Richardson wrote:—"I send you some specimens of what in this district is an entirely new Gooseberry pest." . . . "Last year they were very severe on the bushes in a garden about three miles from here, but this year they are destroying my bushes, particularly the Warrington kind, but are not nearly so bad on the Sulphur Gooseberry." The "Red Spider" was very numerous on the leafage sent. On the 29th of April, Sir J. Stewart Richardson wrote further:—"Since writing to you, I find that the same Spider is very bad on the Ivy, both near the garden and on the house (more than a quarter of a mile distant), so that it cannot be called peculiarly a Gooseberry pest."

On the 1st of May, Miss F. Pye, writing from Knight's Place, Rochester, observed:—"We are sending you some specimens of Red Spider. My father says it has been a nuisance on a piece of Gooseberries for the last two years"; and, a few days after, on the 5th of May, Mr. F. Padwick, writing from 101, Buckingham Road, Brighton, requested "information respecting a minute Red Spider which is committing havoc among the Gooseberry trees in the south of Sussex."

On the 6th of May, Mr. D. D. Gibb, of Ossemsley Manor Farm,

Lymington, Hants, wrote:—"About a week ago Red Spider appeared in great numbers, and still swarms everywhere, the Ivy on this and other houses being covered."

Various other localities were written from regarding presence of the infestation, as at Meldreth, Cambs, on the 16th of May, where it was noted as "more numerous and harder to kill than ever before." Also from Rossett Holt, Harrogate, Yorks, where a correspondent reported a kind of Red Spider, of which specimens were sent, as being in millions on the south and west sides of the house. Without, however, enumerating all localities reported from, the infestation continued past the middle of June, the latest report of presence being sent on the 21st of June, by Mrs. Manning, from Watford, Herts, as follows:—"One tree was slightly attacked last year. This year it appeared in the same branch, but spread over a great number of trees, and I am very anxious to know what means to use to save the bushes from another year's attack."

PREVENTION AND REMEDIES.—One important point is to take the attack in time,—firstly, that if even a single bush is infested it should be cleared so as not to make a centre of infestation for the following season; and secondly, when Red Spider is found to be in possession, remedies should be applied without delay.

This point, it will be seen, is strongly noted in the following valuable communication with which I was favoured by Mr. Malcolm Dunn, writing to me on the 28th of September regarding the injurious insect appearances of the year from the Palace Gardens, Dalkeith, N.B. Mr. Dunn remarked:—

"Our worst 'insect attack' this season was in June, just before the hot weather gave way to rain, on the 22nd of that month. The dry weather and great heat brought on a rather severe attack of Aphis and Red Spider on fruit trees; and especially on Currants and Gooseberries fully exposed to the sun. In gardens where means were not taken at once to stop the attacks, the 'Fly' and 'Spider' quickly overcame the bushes, and many hundreds were so badly injured in the market gardens around here, as well as in private gardens, that they have had to be pulled up and burnt. *Spraying* with soap-suds, or a weak solution of paraffin, at once cleared off the insects, if care was taken to apply the spray to every part, especially the *under side* of the leaves."

Amongst some observations sent me by Mr. J. Masters, of Evesham, Chairman of the Fruit-growers' Experimental Committee of that district, he drew attention to the serious nature of the infestation where it was not attended to. Mr. Masters remarked, "We have had some very serious ravages in our Gooseberry plantations by the 'Red

Spider,' especially where growers took no precautions." Also in one of Mr. Nixon's earliest communications, he wrote:—"I am sending you to-day some Gooseberry cuttings of my neighbours. I do not send my own, because they are not nearly so bad." . . . "I dressed frequently and heavily last year with soft-soap, treacle, and quassia." Mrs. Manning's communication from Watford also points to infestation spreading from even one neglected bush.

For attacks of this nature, probably there are no better applications than spraying with soft-soap wash, or mixtures of soft-soap with mineral oil, or with sulphur. Where these can be successfully mixed at home it saves much trouble, but sometimes purchase of a ready-made mixture saves both trouble and much risk, for if the mineral oil and soap wash are not permanently united, they presently separate, and whilst the soft-soap does not do all the good that was intended, the paraffin does much harm.

So far as reports sent me show, one of the most generally serviceable washes for syringing with, when attack is fairly established, is the mixture sold by Messrs. Morris, Little & Son, of Doncaster, under the trade name of "Anti-pest." On enquiry by myself of Messrs. Morris & Co. as to the general nature of the mixture, they replied:—"We have no objection whatever to your stating 'that the Anti-pest is not distantly allied to the Kerosine Emulsion of the U. S. A., but has the great advantage of being easily miscible with water, &c.,' as no doubt this would be somewhat in its favour."

With regard to special observation of the effect of the dressing,—on March 22nd, Mr. Nixon wrote me, after a deal of experimenting, that he was then able to speak confidently regarding Messrs. Morris, Little & Son's Anti-pest, and considered it undoubtedly the best dressing he had tried, and at the same time he forwarded two boxes of specimens of Gooseberry twigs for my examination. On those that had been dressed there were hardly any "Red Spiders" remaining, and such as there were appeared to be all dead; whilst on the twigs that had not been dressed the "Red Spiders" were mostly quite active; and later on, on May 3rd, Mr. Nixon further reported that he considered he had mastered the "Spider," and did not expect to have much difficulty with it in the future.

Amongst other correspondents much troubled with this Gooseberry leaf pest, I suggested to Sir J. Stewart Richardson, of Pitfour Castle, near Perth (see p. 35), that a trial of the so-called "Anti-pest," applied by the Vermorel Spraying Pump, might prove beneficial, and shortly after he favoured me with a note of results as follows:—"I at once sent for Little's Anti-pest and a Vermorel Spraying Pump; . . . the result of the two things is most satisfactory. This afternoon I inspected some of the bushes most affected, which had only been

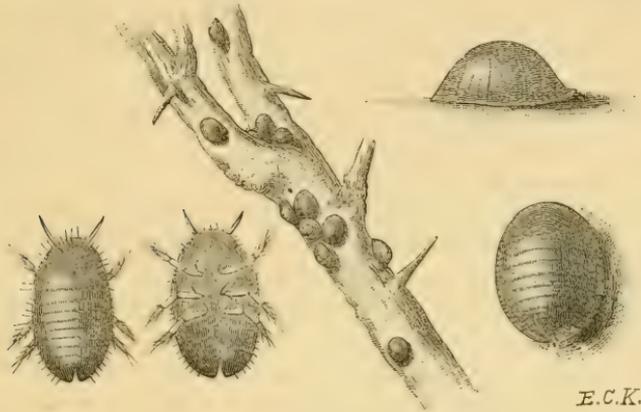
sprayed once yesterday morning, and I could not find a live Spider." . . . "I think the Vermorel Spraying Pump the most wonderful thing for the money I ever came across; it should be in every garden."* The good results remained, for in reply to a request of mine for some more specimens of the Spider, I received a reply, sent on the 3rd of June:—"I shall send you on Monday some infested sprigs of Ivy and Gooseberry. My Gooseberries are cleared by the treatment, but I can get plenty of specimens within a mile."

Very likely many other of the numberless mixtures now purchasable might have cleared out the Red Spider pest equally well, but as this remedy acted satisfactorily in all cases reported to me, and also at no great cost, I usually suggested it, and, as noted, had good reports of its success.

Some applications were noted as doing little good, as for instance, a mixture of soft-soap, quassia, and tobacco; and Mr. J. Masters, writing from Evesham, observed, "Where growers used Paris-green, the bushes are most of them dead."

For general methods of prevention, all cleaning and dressing of Gooseberry bushes during winter, which would remove possible shelters for the Mites, or their eggs, under loose bark, would be desirable; and also (and very especially) all treatment which might destroy the infestation in the ground, or prevent it creeping up the bushes from the ground. One of my correspondents, who bestowed particular attention on this point, observed the "Red Spiders swarming up the stems of bushes" in the early spring; also a report was given me by Mr. Nixon that where the stems of bushes, in his own orchards and in about a dozen other orchards, were greased, there was, in all cases, the same result, namely, the portion between the grease and ground was very quickly covered with Spiders on their way up. And further, during summer, a handful of mould taken up and examined through a hand-glass would show as many as "fifty to one hundred Spiders in it."

* The Vermorel Knapsack Pump, or No. 1 Eclair Sprayer, is procurable from the English agents, Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C. The price, I believe, is 35/-, or thereabouts. This sprayer, or pump, being easily portable on a man's back, is well adapted for use amongst fruit bushes.

Currant and Gooseberry 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.

For several years back notes have been sent from time to time with specimens accompanying, of a brown Scale insect found to infest branches of Gooseberry bushes to an injurious extent. It was not, however, until the past season (1893) that, through the kind and skilled assistance of Mr. J. W. Douglas, F.E.S., I was able to ascertain the precise species of this *Lecanium*.

On the 7th of March, Mr. Douglas wrote me as follows regarding specimens I had forwarded to him for examination:—"The Scales on the Gooseberry are certainly *Lecanium ribis*, Fitch. They are familiar to me, for when I lived at Beaufort Gardens they were gregarious on the Red Currant bushes, and sometimes on the White Currant; but I never found they did much appreciable harm. Yet in some places they are very injurious. I have known bushes to be quite exhausted by them, and once I saw an entire bush of *Ribes sanguineum* (the red flowering kind) entirely killed by them. I never saw or heard of them on Black Currant. The male of the species is unknown." . . . "I sent examples to Signoret, and he agreed that they were the *L. ribis*, Fitch. I doubt, however, if the species has ever been fully described; *i. e.*, only the external characters have been given."—(J. W. D.)

The following is the short original note of observation given by Dr. Asa Fitch, of Albany, U.S.A.:—"Currant-bark Louse, *Lecanium ribis*, n. sp., Homoptera, Coccida. A hemispherical Scale of a brownish yellow colour, about 0.30 in diameter, adhering to the bark of the garden Currant; its margin finely wrinkled transversely; often perforated with one, two, or three holes, from which have issued minute brilliant green, four-winged flies, which in their larva state have fed

upon and consumed the minute eggs which originally existed under the Scales.

“ This is quite common in some gardens, and I suspect has been introduced into this country with the Currant, although European authors have made no mention of a Scale insect as belonging either to this shrub or the Gooseberry. It will be most readily found before the leaves put forth in the spring.”*

The method of life of the Scale insect may be described generally, but sufficiently for remedial purposes, as follows. When the soft whitish lobed female, which lies without power of moving within the thin brown Scale, is matured, she produces a multitude of minute eggs, as small as fine dust, which may easily be observed by detaching the sheltering Scale. From these eggs there hatch little flattish oval maggots, which at first have six legs. These spread themselves actively abroad on the boughs, and feed by sucking away the juices, until presently they lose the power of locomotion, turn to the pupal state, and to common observation change in external appearance to the chestnut coloured hemispherical lumps, which are commonly known as “ Scale Insects.” This thin flexible brown covering shelters the female within; and the sequence of life-history is well given in the following note of observations sent me, on the 15th of July, from Sea-ford Grange, Pershore, by Mr. Wm. F. Gibbon:—

“ I have closely watched the habits of the ‘ Red Scale ’ this season, and have verified my observations of last year. The young Scale emerges from the egg early in the spring; I found them hatched out early in February, at first almost transparent, and walking with freedom on six legs; but they soon became of a chestnut colour, and assumed the shape of a small wood louse, flat and oval, 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* 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.)

* See ‘ Third Report of Noxious and Beneficial Insects of the State of New York,’ by Asa Fitch, M.D., Albany, 1859. This account is also quoted by Dr. Signoret in his ‘ Essai sur les Cochenilles ’ (collective edition), vol. 2, p. 624 (462); and this Scale insect is just alluded to by Prof. J. H. Comstock in his ‘ 2nd Report of the Department of Entomology of Cornell University Experiment Station, 1883,’ in which, at page 135, he refers his readers to the ‘ Trans. N. Y. State Agricultural Society, 1856, 427.

Mr. Gibbon also mentioned that this species of Scale insect is very destructive to Gooseberry and Red and Black Currant bushes. I was not then aware of it having been observed on the Black Currant, but on examination of Black Currants in my own, and in an adjacent garden, I found it very definitely present on the boughs, though not to any great extent. On Red and White Currants it was only too noticeable.

The first observations which were forwarded during the past season of infestation of this Scale insect, were sent me on the 8th of February, from Caldewell, Pershore, by Mr. Charles Whitaker, with samples of Gooseberry twigs accompanying, infested by numbers of the female Scales, and also of the little flat dull reddish larvæ, already on the move.

On March 10th, I found the same kind (both females and larvæ) were very prevalent on Gooseberry bushes in my own garden at Torrington House, 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 the infestation was not noticeable (up to this date) on shoots of last year's growth, although the larvæ, and necessarily the female Scales, had for some time previously been observable on the bushes.

The larvæ, or maggots, 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. 39). The colour various, of some shade of puce or reddish, or ochrey tint, and the body somewhat raised along the middle so as to form a slight keel, and the abdomen of the larvæ, as well as the female Scales, showing a more or less noticeable caudal cleft.

The female Scales were hemispherical in shape, sometimes curved slightly outwards at the lowest edge; the colour some shade of nut brown or rich brown; the size variable, ranging 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. In the best defined specimens the border was finely ribbed transversely; the rest of the surface was so irregularly varied, according to age or condition of Scale, as to make it impossible to give a precise description.

Later in the season (on the 6th of June) the female Scales were plentiful on the old wood of some Gooseberry bushes which had not been particularly attended to, and in most instances were full of eggs. Sometimes the old skin of the mother Scale was almost empty, but in others the quantity was beyond counting, the exceedingly small oval-shaped bodies falling like a shower of white dust, which might be said to cover a space of half an inch square, and well sprinkle about an inch. The Scales which frequently contained the lobed, fleshy, greyish

female *Lecanium* within them, were now of different sizes, and of various colour and condition, some being shrunken, so as to show transverse corrugations, and some plump and rounded.

About a month after (on the 11th of July) a few females were scattered on the old branches, some long dead, and flattened against the boughs with the colour faded, others still bright brown and shiny. Beneath them, in some instances, eggs were still noticeable, but commonly empty eggshells were the most observable presence, together with some eggs still unhatched, and some recently hatched or hatching larvæ. And towards the end of July, though I found little larval presence on the Gooseberry bushes, I found, at the same date, a piece of Gooseberry branch, which had been cut and kept under cover for some time, was sprinkled over with multitudes of the young larval Scales. These were scattered in scores, or rather in hundreds, over every part of the branch excepting the withered leaves, but were then dead from the branch having ceased to supply requisite sap. The marked difference in amount was presumably from the young Scales being washed off in out-of-door circumstances, or destroyed by rain, and also being preyed on by small insect feeding beetles, &c., as there were plentiful remains of egg pellicles.

PREVENTION AND REMEDIES.—Looking at the manner in which the Scales shelter themselves where ragged bark is peeling back on old wood, it is obvious that robbing them of these head-quarters so far as could be managed could not fail to be of service; and next to this, such treatment of the bushes as would allow of not only spraying the infested boughs, but of wash being run down them to lodge amongst rough bark, and would also allow of the oldest of the infested parts, where there was no fear of rubbing off buds, being well brushed with soap mixtures.

Much might thus be done by well considered pruning; but at the same time the pruned off branches should be most carefully removed and burnt. The little larval Scales, though hardly discernible without a magnifier, are actively on foot as early as February, and may perfectly easily wander back from the removed branches if these are left beneath the bushes.

Where Currants are trained in long rods on walls, these require an eye being given, 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.

On the 20th of February, Mr. Chas. Whitaker, writing from Caldewell, Pershore, told me that he had had his infested Gooseberry bushes sprayed with "Chiswick Compound," and found it effectual; and in a further communication, a little more than a month later, he added,

“I found the Chiswick Compound very effective in destroying Scale.” Probably this would be as serviceable an application as could 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.

The mixture is procurable from the Chiswick Soap Company, Chiswick, Middlesex, and is very similar in composition to a mixture used with success in South Australia (under the name of “Burford’s Soft-soap and Sulphur Compound”) against several kinds of bark attack, as Aphides, Red Spider, &c. Probably any of the common soft-soap washes, especially those that are mixed with sulphur and mineral oil, would be of use, and if a stronger application was needed, the following recipe for “Burford’s No. 1 Kerosine Soap” might be of use.

“Take equal weights of kerosine and soft-soap and stir together in a convenient vessel, which should be placed in the sun in summer, or in a bucket containing hot water in the winter time. In from ten to twenty minutes’ time the two ingredients will coalesce, when it can be diluted as required”;* probably in this country the hot water would be more to be trusted to than the heat of the sun at any time of year.

To the above suggestions of preventive or remedial treatment may be added, with regard to date of clearing infested boughs in winter pruning, that it is desirable this should be done, and the Scale-infested boughs cleared from the ground 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.

* The above, and other useful recipes, will be found in the ‘Report on the Fusidiums (Black-spot, Scab, and Mildew Diseases), Codlin Moth, &c.,’ by the late Frazer S. Crawford, Inspector under the Vine, &c., Protection Act, South Australia. E. Spiller, Government Printer, Adelaide.

† In mentioning that stirring the surface soil and throwing on quick-lime is useful, I most particularly wish to observe that I do *not* advise “deep digging” under the bushes as a preventive measure for this or any other Gooseberry attack. As far as I am able to form an opinion, such a measure would be injurious in the extreme to the roots of the Gooseberry bushes, and as a remedial measure for infestation of Gooseberry Sawfly, as I have recently seen recommended, it would (as is well known to practical workers) fail in beneficial effect, as it would merely disperse a large proportion of the cocoons. In this case the surface should be skimmed off no deeper than is necessary, and destroyed with the contained cocoons.—(E. A. O.)

H O P.

Minute Black Lady-bird. *Scymnus minimus*, Rossi.*
(Beneficial insect; feeding on "Red Spider.")

Amongst injurious infestations of Hops, that of Red Spider was especially troublesome at Hop harvest time in the past season, and about the end of August, when in many of the south-eastern Hop growing districts picking was being hurried on, or crops severely suffering from presence of Red Spider,† I received information of observation of a small black Lady-bird Beetle, of which the maggots preyed greedily on this pest.

The first communication regarding these little Lady-birds was sent me on the 5th of August, from Canon Court, Watlington, near Maidstone, by Mr. Edward Goodwin, with the remark that he was forwarding to me some larvæ which he had found that day feeding on the Red Spider of the Hop. This first consignment, however, had escaped in transit, or what was more likely, judging by subsequent observation of habits of the maggots, had destroyed each other past recognition during the journey!

From various causes, the second consignment was not sent me until near the end of the month, on the 25th of August, when Mr. Goodwin wrote:—"I regret the delay in sending you more specimens. Unfortunately the wash we used was more successful in killing the larvæ which prey on Red Spider than the Spiders themselves. I am sending you a very few of the larvæ and pupæ. I could not find any of the beetles; they are very small, black, and evidently allied to the 'Fly Golding.'"

On the 5th of September, Mr. Goodwin added further:—"The larvæ and pupæ are usually found in groups of four or five, and their habits appear to resemble those of the Lady-bird. I can find plenty of them now."

The beetles, which I reared from the pupæ (and in one instance from the larvæ sent me), proved just like miniature black "Lady-birds" in general appearance. The shape hemispheric, or rather oval; length rather less than one line; colour shining black; legs testaceous, with darker thighs; antennæ clubbed, testaceous, lowest joint darker;

* This beetle is not figured, as from its very minute size, a black dot, a twelfth of an inch across, would be the only way of representing it as seen in life. The figure of various Lady-bird Beetles, in different stages, given at p. 46, show in much larger form, the shape of the small *Scymnus* in beetle, chrysalis, and grub condition.

† See 'The London Corn Circular' for August 28th, with "Crop Prospects" of Hops, p. 6.

elytra pubescent and finely punctured. They do not appear to have any popular name; scientifically, they are the *Scymnus minimus*. As I had not met with the species before (though I believe it is not uncommon), I submitted my identification for verification to Mr. O. E. Jansen, who pronounced it correct, and that the beetles were the *Scymnus minimus* of Rossi.

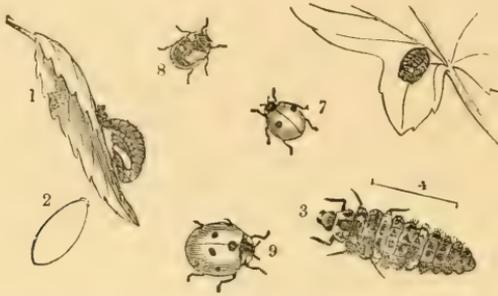
The larvæ (maggots) sent me, which were then on August 26th fully grown, were about an eighth, or rather less than an eighth of an inch in length, and about a third of that width, furnished with six claw-feet, and with a sucker-foot at the end of the tail; remarkably nimble in their movements, and with such power of holding by the tail sucker, that the grub could turn over nearly on its back. Shape narrowly oval. Colour, to the naked eye, smoky grey; on examination with a two-inch object-glass, of a smoky yellowish colour with black markings. The head with some small black marks; 1st segment with two square black patches above; 2nd with two longer black patches; 3rd with two long, but narrower black patches. The rest of the body marked lengthwise, with six rows of black tubercular spots with bristles. On examining the black patches and tubercle-like warts with a higher magnifying power, these proved not to be each a single spot, but composed of a number of little black dots, each aggregation bearing two, three, or, on the larger patches, many white hairs, with here and there a few black hairs also.

On placing the maggots on some Plum leaves infested by Red Spider, I found them shortly after busily feeding. The operation seemed to be going on uninterruptedly and greedily, like sheep browsing on a new pasture. Failing other food, the maggots appeared to prey on each other, for of a few which I had (for convenience of examination) in a corked glass tube, I only found first two or three, and, later on, one live maggot remaining, besides a contorted skin and possible fragments, from which I conjectured the missing specimens had been eaten or destroyed by their companions.

The remaining maggot went through its changes rapidly. On August 28th it was still in larval state; it soon changed in the usual manner of the Coccinellidæ, or "Lady-birds," to a shiny black pupa, suspended to a leaf, and on the 6th of September the beetle had developed, and was walking about actively.

From the good number of specimens sent me, I was enabled to watch the development from larval condition onward to that of the perfect beetle, and I have given notes as above of the chief points observable, as I am not aware of the history having been noted before. The only special reference which I find to this *Scymnus minimus*, as a destroyer of Red Spider, is given by Dr. E. L. Taschenberg in his 'Praktische Insekten Kunde,' pt. v., p. 154.

The figure appended of some of our better known, and very much larger Lady-birds, conveys equally well the shape (much magnified) of the little black *Scymnus* and its larva, and also the manner in which it suspends itself for its pupal change. With these larger species of Coccinellidæ, the attempt has, I believe, been sometimes made, with



COCCINELLIDÆ.—1, cluster of eggs; 2, egg, magnified; 3, grub, magnified; 4, line showing nat. length; 5 and 6, pupæ; 7 and 8, 2-spotted Lady-bird, and dark variety, sometimes known as *Coccinella dispar*; 9, 7-spotted Lady-bird.

tolerable success, to preserve the beetles during the winter, and to turn them loose afterwards to prey on the Hop Aphides. How far such a plan could be carried out, excepting just as a matter of fancy, might be doubted, but in the case of the little *Scymnus*, through the courtesy of Mr. Goodwin, I have been supplied with a sufficient number of specimens to found (if they prosper) a colony in my garden. As far as I see, the flight of the beetle is very short, and if established in a spot where they may hibernate undisturbed, their services may just possibly (without any attention having to be bestowed on them) be secured for next season.

LOCUSTS.

Locust (a species of Southern Europe). *Acridium egyptium*, L.
South American Migratory Locust. *Acridium (Schistocerca) paranaense*, Burm.



ACRIDIUM ÆGYPTIUM.

In the early part of the past year (1893), some specimens of Locusts which had certainly, in some cases, and presumably in all, been imported into this country, were forwarded to me by correspondents. Of these, two very fine specimens, sent from two different localities, were still alive, and one in active condition; others which were dead, and obviously had been so for some time, were found in such great numbers in Lucerne (Alfalfa), imported as fodder from Buenos Ayres, in South America, that it was estimated there was one Locust to each pound of hay in the fodder examined.

Later on in the year, at the beginning of September, another application was sent me on the part of a farmer in the neighbourhood of Caversham, in Oxfordshire, who had just purchased some "foreign hay," and found quantities of Locusts in it to the amount of "not less than two hundred specimens in one truss." These Locusts (with one possible exception) appeared to be of precisely the same species as those imported from Buenos Ayres, and like them were all dead.

The figure at the head of this paper, which was sketched from one of the live specimens sent me, gives also a good idea of the general appearance of the fine insects, commonly known as Locusts, when at rest, or preparing for one of their long leaps.

For common purposes, Locusts may perhaps be best described as a very large kind of what, in this country, we call "Grasshoppers," and the family to which they belong (*Locustida*, Leach) is distinguishable from others of "Saltatorial Orthoptera," such as our English House Crickets, Field Crickets, and the like, by the horns, or *antennæ*, being thread-like, or cylindric, and short, not exceeding the body in length; by the wing-covers, and the folded wings beneath them, being deflexed, that is, not placed horizontally, but sloping like the roof of a house;

and also by the ovipositor not being exerted, the extremity of the tail not being prolonged into a long egg-laying apparatus. The size is very variable, from that of the little Grasshoppers, which we are well acquainted with here, to from two to about three inches in length from head to tip of wings when at rest in the case of some of the larger Locusts of the western and eastern world.

The first specimen I received in the past season was sent me on the 31st of January, from Harlington, Middlesex, by Mr. Robert Newman, with the remarks:—"I have just had handed to me a species of Grasshopper, which I send to you by this post. The same was found in a white Brocoli bought in the London market, and which was sent there from some foreign district. I shall be glad if you will tell me what it is, and whether there is any reason to fear danger from the importation of the same."

On examination of the specimen, it seemed to me that it was most likely it had been imported from the south of Europe, and on enquiry I found many Brocoli had then been lately imported from Spain.

A few days after receipt of the above specimen, another Locust of the same species, though rather larger and somewhat differing in marking, was forwarded to me by favour of Messrs. West, Newman & Co., 54, Hatton Garden, London, E.C., with the following note:—"This morning a lad named Fursdon, kitchen-boy at Spiers and Pond's Aldersgate Street Hotel, brought the Locust sent herewith, which he had found among some 'greens' sent in from market. I could not extract any information as to the origin of the greens. It struck me that here might be the importation of a serious injurious insect attack, and so send it off to you."—(T. P. N.)

Both of the above specimens were alive, and apparently in good health. The length of the specimen figured (p. 47) was two inches or slightly less in the body; two and three-eighth inches from head to tip of upper wings when at rest; general colour reddish mottled with greyish, yellowish red mark at the hinder part of the head, and eyes with alternate fine longitudinal lines of black and yellowish, these upwards of fourteen in number. The narrow parchment-like, and somewhat transparent, upper wings dark grey, mottled with many darker grey spots, these smaller along the fore edge. The posterior legs with three dark blotches along the upper part of the thigh (*femur*), and the shanks (*tibiæ*) with white spines black at the tip. The above short description of the general appearance of these Locusts, together with the figure at p. 47, will perhaps be sufficient for agricultural use; those who desire full technical details will find them excellently given in the work noted below.*

* 'Sinópsis de los Ortópteros de Espana y Portugal,' par Ignacio Bolivar, Madrid, pp. 88, 89.

As I have not a type collection for reference, it was impossible for me to identify the specimens trustworthily, and I therefore forwarded them to Senor Don Ignacio Bolivar, Professor of Entomology in the University of Madrid, well known for his long and also widely extended observations on the Orthoptera, who was good enough to identify them for me as the *Acridium ægyptium*,* L., and to write as follows regarding them:—

“Nos. 1 and 2 certainly correspond to the *Acridium ægyptium*, L. They may easily have been imported into England with field produce from the whole of Southern Europe, where the species is common. In the neighbourhood of Madrid this kind may be found in fully developed condition during nearly the whole year. It does not cause ravage, as it is not found in great numbers, but always as isolated specimens, and scattered at considerable distances.”—J. B. (Trans. E. A. O.)

Besides the above specimens, which arrived in living condition, I received, on the 3rd of February, a packet of large dead Locusts, which proved on investigation to be the *Acridium paranense*, of Burmeister, and which were then being sent over from Buenos Ayres, in fodder, in such numbers as to cause enquiry whether the great quantity might prove injurious to cattle or stock consuming the Locusts with their food.

On this point the following communication was sent me on the 2nd of February, by Messrs. Porter & Wilson, from Jamaica Street, Liverpool:—“I beg to hand you sample of insects taken from Alfalfa grass or hay, which is being landed at this port from Buenos Ayres. In two samples I have examined, the quantity averages about one insect to each pound of hay. The specimens are not quite perfect; they have some long legs, which got broken off through being entangled amongst the leaves of the herbage, which is very full towards the top, something like the Vetches of our country. I shall esteem it a great favour if you will kindly tell me the name of the insect, and if it is injurious to horses or cattle.”

It may be just noted in passing, that “Alfalfa” is the Spanish word for Lucerne. With regard to possible damage, as a presence of infestation at the above-named proportion would be calculable as at

* Synonyms of *Acridium ægyptium*, L. :—

“*Gryllus (Locusta) ægyptius*, Linneo. Mus. L. Ulr. pagina 138 (1764).

“*G. cristatus*, Asso., 1784. Introd. in Or. et Zool. Arag., page 111.

“*G. lineola*, Fabricius, Ent. Syst. 11, p. 54.

“*Acridium lineola*, Serville, Hist. Nat. des Orth., p. 656.

“*A. tartaricum*, Serville, id., pag. 657 nota. Fischer, Fr. Orth. Eur., p. 388

t. xv., fig. 27, 27 a.

“*A. ægyptium*, Staal, Recens., 1 a part, p. 63.”

See page 88 of the work above quoted.

2240 dead Locusts to the ton of fodder, the point of whether or not they might be prejudicial to the health of stock certainly appears of some importance. So far as the bodies of the Locusts are concerned, these might be considered perfectly harmless, from the knowledge we have of the manner in which various animals feed on them, when they can get a chance; also when cooked, and the legs removed, they have long been known to be in some localities an article of human food. But when the insects are consumed entire in a dried state, and in great numbers, it appeared to me open to doubt what effect the hard legs, and especially the hinder legs, with the shanks about an inch in length beset with sharp spines, might have by causing internal irritation, or in the case of cattle, forming balls. Therefore, as I was unable to give a trustworthy opinion on the subject, I suggested it would be well to apply to a veterinary adviser.*

This species of Locust is one of the migratory kinds of South America, of which the native home is stated to be in the higher barren plateaux of the Argentine Republic, and which are recorded as abounding in the provinces of the La Plata river. It is of this kind that Darwin, in his journey across South America from Buenos Ayres to Mendoza and Chile, fell in with a vast swarm just alighting from their migratory flight in the neighbourhood of Luxan, † about a hundred miles from the first-named city.

With regard to the large Locusts mentioned above, as forwarded to me in "Alfalfa hay" imported from Buenos Ayres, they appeared to me to be the *Acridium paranense*; but as I could not feel certain I forwarded specimens, together with those of the *A. ægyptium*, to Senor Don Ignacio Bolivar at Madrid, who kindly confirmed my view as follows:—"No. 3 is, without doubt, the *Acridium* (or rather the *Schistocerca*) *paranense*, Burm., which causes much ravage in the southern parts of America."—(J. B.)

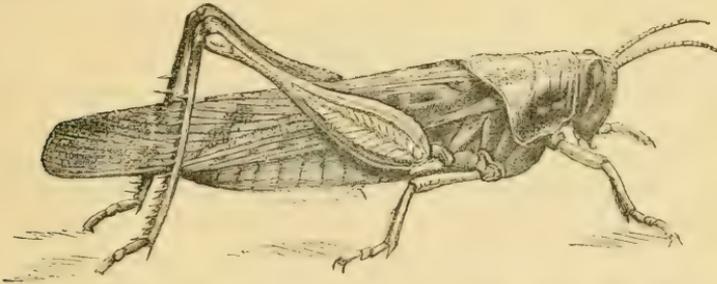
The specimens in the flattened damaged state in which they reached me were of a general brownish colour. The head mottled with various tints, including reddish pink; the body between the

* In the course of further search on Locust life, I noticed the following communication to the editor in the 'Agricultural Journal,' published by the Dep. of Agriculture for Cape Colony, No. 16, Vol. vi. (August, 1893, p. 311):—"The sheep have been living on live Locusts for the last three months, which has (as we think) caused abortion in a large number of the ewes. Mr. Jim Miles informed me that all his ewes had cast their lambs prematurely, and therefore the sheep do not seem to recover as they should."—(J. K.) The consumption of Locusts to such an amount as to be considered the sole article of diet of the sheep, is of course very different to even the large numbers above mentioned as mixed with the hay; still the observation may be worth notice.

† See 1st Report of U.S.A. Ent. Com., p. 466; and for list of publications on S. American Locusts, see App. xxvii. to same vol., pp. [278] and [279].

wings striped lengthwise above with various shades of yellowish brown, and deeper brown, or with deep brown striped with a still deeper shade; the hind shanks coral-red, with white spines, black at the tips. The narrow parchment-like upper wings with a pale narrow stripe at the fore edge, and also for rather more than half the length at the hinder edge, with an area between the two stripes, narrow at the base and gradually widening, marked with angular brown blotches, these dark near the base, and fainter towards the tip of the wing. Beneath these elytra or upper wings is folded a pair of delicately transparent wings of ample size.

The colours of the body were necessarily to *some degree* altered by the conditions of transit, but the accompanying figure of the "American *Acridium*," the *Acridium* (or *Schistocerca*) *americana*, Drury, gives a very good idea of the appearance of the specimens sent me from Buenos Ayres, and especially of the quadrate fuscous markings on the upper wings.



AMERICAN ACRIDIUM.—*Acridium* (*Schistocerca*) *americanum*, after Riley.

This Locust is one of the migratory kinds of North America, but appears almost to require mention here on account of its great resemblance (or, as some consider, its probable identity) with the *A. peregrinum*, the migratory Locust of North Africa and S. Western Asia, which species is also so exceedingly similar to the *A. paranense*, entered on in the preceding pages, as to make it doubtful whether these also may not be mere varieties of one species.

In the 'First Report of the U.S.A. Entomological Commission,' p. 37, it is noted, in observations of this North American *Acridium*, "that one of the most destructive migratory species of South-Western Asia and Northern Africa (*Acridium peregrinum*) is not only congeneric with this species, but so closely resembles it that ordinary observation would scarcely detect the differences between the two." And (continuing the records of similarity) various writers are of opinion that this *Acridium peregrinum* does not really differ from the *A. paranense* of the Argentine Republic. Thus we have before us the very interesting

fact of these migratory hordes of the genus *Aceridium*, which devastate respectively part of North America, part of South America, and also the South-West of Asia and the North of Africa, being so exceedingly similar to each other in appearance, that although they are specifically distinguished as *americanum*, *paranense*, and *peregrinum*, it is at least open to doubt whether they are not all of one species.

Under the name of *Aceridium peregrinum*, this large Locust of India and Africa occasionally visits our shores, but there does not seem to be any reason to apprehend that either this kind or any other of the Locust family (as distinguished from the small form, known in this country as Grasshoppers) will make good an establishment in this island.

From collation of information, and also of quotations given in the U.S.A. Department of Agriculture reports, and also Entomological records of this country, it appears that the first trustworthy return of noticeable Locust migration reaching us was when the migratory Locust, *Pachytylus migratorius*, after multiplying in Southern Russia in 1844, passed westward and northward in the following years; and in 1846 numerous flocks of Locusts were recorded as observed in the South and North of England, in Scotland about Aberdeen, and in the Shetlands. Since that date Locusts of various species have been not unfrequently recorded scientifically, as present in various parts of the country, usually as single specimens, or just a few, and now and then (or at least once) in numbers, described as an erratic flock. But so far, as I find these Locusts were all fully-developed specimens; I cannot find any notice of appearance of the insects being in any case followed by observation of them in their early conditions.

The Locust is one of the insects which does not alter in general shape from the time that it hatches out of the egg to its maturity, save that at first it is totally wingless. The little infant Locust (as I had once an opportunity of seeing myself) is hearty and brisk as can be, just after coming out of the egg; and as soon as food supply is exhausted in localities where a great hatch has taken place, the young destroyers move on devouring (in the words of the U.S.A. official report before me) "all the grass, grain, and garden-truck in their path." In due time, after successive moults, as the creature grows to full development it acquires wings, the upper pair narrow and somewhat parchment-like, the lower transparent, and of such great size as to require many folds to pack them away beneath the upper pair; and if the pasturage is not sufficient, and it is one of the gregarious and migratory species, the Locust and its millions of brethren set forth on their wanderings in the vast armies in which its presence has been recorded as one of the scourges of the earth for thousands of years.

The eggs are laid in the ground, and the average time of develop-

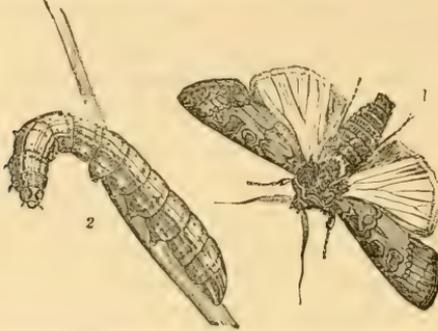
ment, from date of hatching to maturity, is given in the cases recorded regarding *Acridium americanum* as being seventy days.

With regard to this country, it is probable that from climatal, as well as other considerations, there is not the least cause to fear establishment of this infestation; still as the observation of these great insects necessarily attracts much attention, and sometimes not unnatural apprehension, and as with the increasing amount of importations of human food and cattle fodder it is probable their presence will be more frequently observed, it has seemed perhaps desirable to give a few notes in connection with the insect observations of 1893.

Note.—Those who wish to follow up the subject will find enormous masses of information on almost every point connected with Locust life-history, whether Entomological, Geographical, Meteorological, or Historical, with methods of prevention and remedy, in the large volumes entitled respectively 'First, and Second, Annual Reports of the U.S.A. Entomological Commission, Washington'; also in Appendix xxvii., pp. 273-279, of 1st Report above named, will be found bibliographical references. Much information will also be found in successive reports of the State Entomologists of the U.S.A. Information on the "Locusts of Bengal, Madras, Assam, and Bombay," will be found in the 'Indian Museum Notes,' Calcutta, prepared by Mr. E. C. Cotes, of the Indian Museum; and many short notices of observation of appearance of Locusts in Great Britain will be found by reference to indexes of the 'Entomologist's Monthly Magazine.'

MANGOLDS.

SURFACE CATERpillARS.—Caterpillars of the **Turnip or Dart Moth**, *Agrotis segetum*, Ochsenheimer; also of the **Heart and Dart Moth**, *Agrotis exclamationis*, Linn.



AGROTIS SEGETUM.—Common Dart or Turnip Moth and caterpillar.

So surely as the year comes round, damage, more or less severe, is caused to root crops by the large grubs, known as "Surface Caterpillars," of which one of the two commonest kinds is figured above, and the other at p. 59, together with the moths, to which they respectively turn. In some years these caterpillars are so constant in their presence that they have been reported as observable during almost every month. This was the case in 1884, when observation of the grubs as lively and active began in February, and still on the 13th of December the same kind was reported (due details and specimens accompanying) as ravaging in the neighbourhood of Selby, Yorks, to a serious extent.

Commonly, however, though their life in regular course extends through the winter, they are so much acted on by ordinary amount of cold, as to rest quietly without doing much harm at a depth beneath the surface, where they are safe from weather influence. Commonly also, although these caterpillars are destructive below ground to almost any of our root crops on which they may chance to have established themselves, they are so very especially injurious to Turnip bulbs, that the names of Turnip grub and Turnip Moth are given to the infestation. It is in connection with this crop, and under this name, that this infestation has chiefly been noticed in the preceding numbers of these Reports; but in the past season, although the grubs did not fail to make their customary appearance at the roots of Turnips, Potatoes, &c., yet it was to Mangold roots that they were so especially and unusually injurious, that the attack was in many places not recognised as being of the old established kinds of "Surface Caterpillars," and enquiry

regarding its nature was forwarded from many localities, chiefly in the south of England.

The first communication was sent me on the 19th of June, by Mr. W. H. Hunt, from Outmarsh, Trowbridge, Wilts, with specimens of grubs which were destroying his Mangolds by "eating them off just under the ground," and an enquiry as to what was the best remedy. All of the specimens, that arrived in fair condition, were apparently caterpillars of the Turnip or Dart Moth, *Agrotis segetum*, but they differed much in age, and also in colour, from a pale tint to such a deep colour that the spots on the back were hardly distinguishable. Amongst the difficulties of certain identification of the very similar common kinds of "Surface Caterpillars" from each other, it should not be overlooked that whilst some of a consignment may be shrunken, and altogether out of typical condition of colour and skin, from starvation and knocking about in transit; that others may be glossy, and as full as they can hold, apparently simply from consumption of their fellow-travellers.

On the 3rd of July, Mr. Edw. R. Berry Torr, wrote me regarding prevalence of grub in Mangolds as follows, from Westleigh House, Bideford, N. Devon:—"The grub is in the Mangold nearly throughout the county; . . . many farmers have no Mangolds left; . . . my neighbour has all his men and their children picking them from round the plants." In this case specimens were not sent, but a little more than a month later, on the 10th of August, Mr. Berry Torr, continuing the subject, added:—"Re Surface Caterpillars,—they have been most troublesome here this season, though I have got on far better than many of my neighbours. They have devoured Cabbages, Mangolds, or anything else they could get at, and nothing seems to stop them."

On the 6th of July, the Rev. W. F. Newman, of Hockworthy Vicarage, Wellington, Somerset, who was then having the Aphides*

* In a communication sent me by the Rev. W. F. Newman, on the 1st of July, he mentioned that his Mangolds had been attacked by what I found on examination were Aphides, commonly known as Plant Lice. These being on the under side of the leaf, the measure tried of dragging a bag over the leafage did little good. Therefore Mr. Newman put on a body of workers to remove the Aphides by rubbing them off with their hands; but for the sake of himself and his neighbours, he was desirous to know whether there was any more expeditious remedy. Later in the year, on September 13th, he further mentioned, "My crop of Mangolds that was hand-rubbed for Black Aphis promises to be a very fair one."—(W. F. N.)

On the same day, that is, on the 1st of July, Mr. G. A. Winder wrote to me, from Fairmile, Ottery St. Mary, regarding "a terrible pest on the Mangolds" in the shape of fly. This also infested a weed growing among them, locally known as Calf-tongue, on which there were likewise some beetle grubs observable. On examination the insects proved to be Mangold Aphis, with the grubs of Lady-birds, which are amongst our best natural helpers against Aphis attack, already in attendance.

This attack, like that near Wellington, Somerset, was during the continuance

on a three-acre field of Mangolds carefully attended to, wrote me that some sort of grub was found at the roots, of which he was going to send a specimen, as it had been pretty general there in its depredations, and two days later he forwarded me samples with the following note:—“According to promise I am forwarding three specimens of Mangold grub just sent down to me by a farmer in this parish.” . . . “They attack the root of the plant, and I hear that several farmers in the neighbourhood have ploughed up their Mangolds because of the depredations of these active little gentlemen.” The sample was much shrunk on receipt, but was of “Surface Caterpillars,” and so far as could be made out by markings still noticeable was of the *Agrotis segetum*.

On July 7th, Mr. Wm. Hooper (Editor of the ‘Farmer’s Gazette,’ Dublin) favoured me with the following note of damage to Mangold plants then going on in the neighbourhood of Thorne, Yeovil, Somerset, where he was then staying; samples of the infestation, which proved to be of Surface Caterpillars, were sent accompanying:—“Many Mangold plants here are bitten off at the root, like, and by the enclosed specimens.” . . . “These specimens are from a farm at Thorne in the occupation of Mr. John Marsh, and similar damage has been done on contiguous farms.”—(W. H.)

Specimens of Surface Caterpillars were also sent to me on the 30th of July, from Dare Field, Chudleigh Knighton, Newton Abbot (South Devon), by the Rev. F. G. Riley, as samples of a grub which was causing the greatest destruction amongst Turnips and Mangolds, and was also (in his own garden) eating off Cabbage plants. Mr. Riley urgently begged for information which might help them in dealing with the infestation, adding the remark, “We seem to be helpless and without remedy against the enemy, so numerous are they this year, as many as fifty round a single Mangold.”

Numerous specimens of Surface Caterpillars were again sent me somewhat later on by the Rev. W. F. Newman with the observation, “I have now procured some more of the Mangold grub from a farm of mine up the Dart.” Some of the specimens sent were apparently fully grown.

From Kent, and, later on in the season, from some other southerly

of the general drought, and appears worth mention just to show the prevalence of insect attack under the circumstances. In 1885, during a time of drought, Mangolds, as well as Turnips, were infested by Aphides. These are sometimes taken for the so-called “Collier,” the black Bean Aphis, but are more probably the *Aphis papaveris*, which is known to infest Mangolds, or the *A. atriplicis*, which is found on *Orache* and other plants nearly allied to Mangolds. From the many points of resemblance between these three kinds, specimens are needed for certain identification.—ED.

localities, notes were sent of damage to Mangolds from Surface Caterpillar attack.

During July, an enquiry was sent me on the part of Mr. John Pye, of Ranscombe, Cuxton (near Rochester, Kent), regarding caterpillars, apparently of the *A. segetum*, which were doing great damage in a field of Mangolds.

Early in September, Mr. F. O. Solomon (Lecturer on Agriculture in connection with the Durham College of Science) forwarded specimens of Surface Caterpillars from Southfield, near Dartford, as samples of grubs which were doing great damage on farms in the neighbourhood of Cobham (Kent), but which were, so far as observed, not attacking any but the Mangold crop.

At a locality in Essex (Greenhills, Earl's Colne), damage to various root crops was reported to me on September 22nd, by Mr. J. A. Tawell, as being caused by these "surface" grubs. Mr. Tawell mentioned it as "a recent trouble that has come to the Mangold, Potato, and Turnip roots," of which he enclosed specimens, adding, "the Mangold is seriously attacked; the Potato as you will see." The sample of Potato attack showed the damage to be very great, the caterpillars, of which samples were forwarded, having eaten great holes into the tuber.

I was also kindly favoured by Mr. Thos. Collins, of Birtley, Witley, Surrey, with some interesting notes of observation as to presence, &c., of Surface Caterpillars on the Earl of Derby's estates in that neighbourhood. On the 23rd of September, Mr. Collins wrote, amongst some other observations on field insect pests:—"There is a dark coloured grub which has done a lot of damage in the Mangolds this year. It began when the plants were very small, and may still be found amongst them in large numbers. It seems to abound on almost every farm in this district this year. The men have looked carefully for them when hoeing, and killed great numbers of them."

A few days after, in a communication regarding some differences in colour of the grubs, and some details of other attack, Mr. Collins mentioned: "I know of two or three instances in which the Mangold seed was put in very late, and which were comparatively free from grub, whilst those drilled about the second week in May were rather worse than the earlier ones."

This difference in amount of attack appeared to me to be very likely attributable to the Mangolds not having come up and been ready for attack, before the moths laying the eggs, which produce the surface grubs, had passed away. Commonly weather is variable, and also locally different, and there is very likely to be difference in dates of insect presence, which, if early hatches of the moths had died out, might supply us with plenty for later attacks. *But last season* the long steady drought gave us a widespread similarity of weather, which, con-

jecturally at least, might give great similarity of date to these caterpillar pests.

On suggesting this to Mr. Collins, he considered that this was very likely the explanation, and wrote me:—"No doubt your suggestion is correct about the moths being hatched and laying their eggs before the late sown Mangolds were up, and this would also account for the little damage the caterpillars have done to the Swedes and White Turnips compared with the Mangolds, which were sown earlier. The very first sown Mangolds did not suffer quite so much as those sown about a fortnight later, but perhaps they were larger plants, and better able to withstand the attack of the grub. In some places they are producing half a crop where the second sowing had to be ploughed up again."—(T. C.)

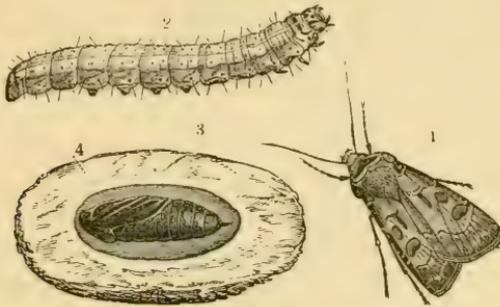
Other communications were sent me regarding damage from Surface Caterpillars then going forward to various crops, especially Turnips; but also to roots of Cabbage and Strawberry plants, and to Maize. From Wickham Market, Suffolk, the grub was reported, on July 24th, as doing immense mischief to the Turnip crop in the neighbourhood by biting the root of the young plant in two. From near Cheam, Surrey, at nearly the same date, a correspondent mentioned he had several fields of Brussel Sprouts, and Cabbage, which were being eaten off by the pests, and that they had also attacked a field of Strawberries.

On the 24th of July, Mr. G. S. Mitchell, writing from Adhurst St. Mary, Petersfield, Hants, mentioned attack, which proved like the others previously noticed to be of Surface Caterpillars, having "first appeared in a field of White Turnips, and have quickly cleared off about four acres quite clean." At date of writing, Mr. Mitchell noted, they seem now to be firmly established in the next field, which is Maize sown for ensilage purposes; and a few days later he added:—"The number of caterpillars seems now to be very materially reduced, owing to a heavy night's rain we have had, but I fear it looks very doubtful for second drilling of Turnips, which are now just coming up." He also mentioned in the same letter: "I have just heard from one of our neighbours, who farms upon the chalk, that he has lost all his Mangold and Rape by apparently this same pest."

A note of enquiry was also sent me from Peterborough, on the 30th of August, by Mr. Sidney T. Smith (Proprietor of the 'Peterborough Express'), requesting information and advice as to best method of extirpation of the grub which was then destroying the White Turnips in the surrounding district. The specimens sent were nearly full-grown, and were more characteristically Turnip grub, that is, larvæ of the *Agrotis segetum*, than can be certainly said of many Surface Caterpillars sent me, in the condition to which, without careful packing, they

are almost sure to be reduced by a journey in unnatural surroundings, and possibly without vegetable food.

The figure at p. 54 represents the very common kind popularly known as the Turnip or Dart Moth, and its caterpillar, and, so far as could be judged, most of the specimens sent were of this species, scientifically, the *Agrotis segetum*. The kind figured below is often almost indistinguishable from the above in larval, that is, caterpillar state. It has the popular name of the Heart and Dart Moth, and, as



AGROTIS EXCLAMATIONIS.—1, Heart and Dart Moth; 2, caterpillar; 3 and 4, chrysalis in earth-cell.

often mentioned before, the two kinds closely resemble each other in their habits. The common method of life is for the caterpillars to feed at the roots of almost any kind of crop, though by preference at succulent roots, as Turnip, or at Potatoes, or Mangolds. During winter weather, and their conditions permitting, they may continue feeding, or may pass it in cells in the earth. On the return of mild weather, such caterpillars as have survived come out again to feed, and presently turn to chrysalids at or near the surface of the soil, from which the moths appear in due course, and lay their eggs during the summer, as early as June, or towards autumn.

We are still apparently no further advanced towards finding a remedy for this destruction, but in the above observations we have one note of the plan of hand-picking, which appears to be the only really practicable method of clearing out this pest, being adopted. We have also a note, on the good authority of Mr. Thos. Collins, of adoption of the plan of hoeing as a means of getting rid of a proportion of the pests. The notes of failure of various dressing to do good, I have not thought it necessary to go into again; but the observation at p. 58 of the caterpillars seeming to be very materially reduced after a heavy night's rain, is worth notice.

It has been a well-observed fact that sometimes caterpillar prevalence has been checked by sudden rain in hot weather, the result being that the contents of the caterpillar are voided, and the creatures perish.

It is not apparently feasible to apply this treatment for field use, but in garden cultivation, where there is a plentiful supply of water, and a hose, something might be done to carry out the principle. But with regard to "Surface Caterpillars," their history, and the need of more practicable methods of getting rid of their destructive presence, is so well before agriculturists, both here and in America, that I have only alluded to the subject again this year in connection with the unusual extent of observation of prevalence of their attack to Mangolds.

Surface Caterpillars at roots of young Conifers.—The following note, sent me on November 9th, by Mr. F. O. Solomon, Lecturer in Agriculture at the Durham College of Science, Newcastle-on-Tyne, gives an interesting observation of the omnivorous propensities of the "Surface Caterpillars," which, in the absence of such food as they may especially prefer, appear, as has been occasionally remarked of them, to attack any kind of root that their jaws can bite into.

Mr. Solomon observed:—"What pests the Turnip grubs have been this year! We have at the College a small plot (thirty-three square yards) planted with Conifer seedlings. The little plants have been eaten off close to the ground. We could not imagine what was doing the damage for some time, but when we scraped about for grubs, we collected sixty-six on the thirty-three square yards in a very short time. They are most omnivorous feeders certainly."

MUSTARD.

Mustard Beetle. *Phædon betulæ*, Linn.

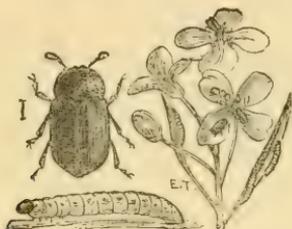


PHÆDON BETULÆ.—Mustard Beetle, nat. size and magnified; maggot, magnified, and nat. size on leaf.

For some years back, injury by insect attack to the Mustard crop has become so manifestly a matter requiring attention, that early in

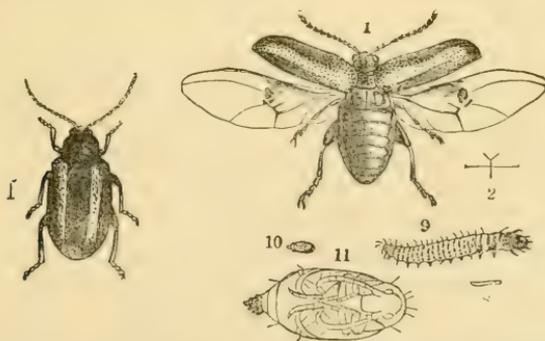
the past season much consideration was devoted, and consultation took place, as to what could be done, not only amongst Mustard growers, but amongst those also cognizant of the needs of the case from being, in various ways, interested in results of the Mustard crop.

As one obviously important point was circulating all available information, a four-page leaflet was issued by Messrs. J. and J. Colman, of The Carrow Works, Norwich, embodying useful, straightforward observations on the appearance and habits of the "Mustard Beetle," and of the "Turnip-flower Beetle" (*Meligethes aeneus*), which sometimes is not far behind the Mustard Beetle in the damage it causes, these



MELIGETHES AENEUS.—Beetle and maggot, magnified, and infested flower, and line showing nat. size of beetle, after Dr. Taschenberg.

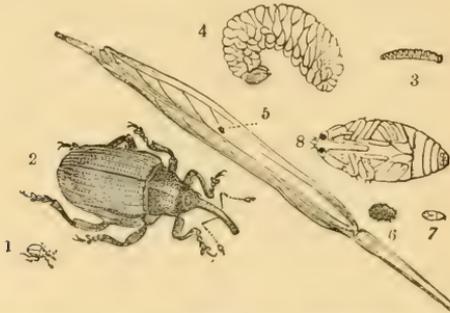
notes being accompanied by figures of the insects, and suggestions as to measures of prevention and remedy.



PHYLLOSTRETA NEMORUM.—Beetle flying, and at rest; maggot and chrysalis; all magnified, and with nat. size.

Much about the same time, as I found that there was a good deal of uncertainty abroad as to distinguishing various kinds of Mustard attack, I also issued a leaflet for distribution, with figures of four of the most destructive of the common kinds of infestation, namely, the Mustard Beetle, figured at p. 60; the Turnip "Fly," or Flea Beetle (figured above), which is sometimes a bad Mustard pest; also the Turnip "Flower Beetle" (figured above), a most serious infestation; and the Turnip-seed Weevil (figured at p. 62), a very minute beetle,

easily distinguishable (with the help of a magnifying-glass) from the above-mentioned kinds, both by its shape and colour. This very little beetle is greyish in colour, and furnished with a long curved snout, or proboscis, and is very nearly allied to the little weevil which did a good deal of harm last season to Mustard plants just when they were first sprouting. Of this, the *Ceutorhynchus contractus*, some notes are given separately under the heading of its special name further on.



CEUTORHYNCHUS ASSIMILIS.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa; all nat. size and magnified; 5, infested Turnip pod.

The history of the Mustard Beetle has been so often given that it seems almost unnecessary to repeat it. Still to save reference I note it again as condensed into as short space as possible in my leaflet above mentioned.

The Mustard Beetle is of a deep full blue or greenish colour above (so shiny as to be almost of a glassy lustre), and black beneath. The legs and horns are also black. It is oblong-oval in shape, about the sixth of an inch long, slightly punctured on the back, and has two wings.

The grubs, which are of the shape figured at p. 60, are about a quarter of an inch in length when full-grown, slightly hairy, of a smoky colour, spotted with black, with black head, and stout black conical horns, lighter at the base. They have three pairs of claw-feet, and a sucker-foot at the end of the tail, and along the sides of the body are a row of tubercles, from which the grubs have the power of protruding a yellow gland.

The method of life is for the beetles to winter in any convenient shelter, in the most various kinds of localities. It may be in the ends of Mustard stocks, or in the roots of old Mustard plants left on the land, or in rough shelters made of Mustard straw; in ditch or hedge-banks, in the earth or in the rough grass, or at the bottom of hedgerows. Also they are to be found in crannies of walls, gateposts, old wood or bark, and are especially noted as fond of sheltering amongst

the reeds and rushes, by ditches and drains ; in fact, in any available shelter.

From these winter quarters the beetles come out in spring, and spread to any food-plant near, and especially amongst wild plants, to Cresses or Charlock, or to others which, like Cabbage, Turnip, or Mustard, are of the cruciferous kind. These various plants serve the beetles for a place for their egg-laying until the Mustard is ready, consequently to clear what may be called the *nurseries* of the year's attack, as well as to prevent, so far as may be reasonably possible, winter shelters being left for the parent beetles, are respectively methods of lessening coming attack.

On these food-plants the beetles which have lived through the winter lay their small eggs, and then they die. The grubs feed voraciously until they are full-grown, when they go down into the earth to turn to chrysalids. From these the summer brood of beetles come out in about a fortnight (it may be more or less), and these start new attack, and thus the infestation goes on, which may continue until quite late in the autumn.

With the history of the Turnip Flea Beetle we are all fairly acquainted.

The Seed Weevil destroys the seeds in the pods of various plants of the Cabbage tribe, and is sometimes found in flowering heads of Mustard.

But of these infestations the worst, excepting the "Mustard Beetle" itself, is that of the *Meligethes*, the Turnip-blossom Beetle. This I had the opportunity of studying the life-history of, on Rape or Cabbage, some years ago, in full detail day by day, and in all conditions, from deposit of the egg by a great infestation of beetles, to the descent of the grubs into the ground for change to the chrysalis state, and in the course of observation the destructiveness of their operations to the buds and flowers, and, as the grubs grew larger, to the neighbouring stems was exceedingly noticeable.

Its life-history may be shortly given thus:—When the Mustard plant is knotting for flower, the opening buds and blossoms are very often attacked by the "Turnip-blossom Beetle," the *Meligethes æneus*. This is of much the same shape as the "Mustard Beetle," but rather smaller, and of a duller or more brassy green. The eggs are inserted by the beetles in the buds ; the grubs which hatch from these are whitish, with broad purple head, and some purplish markings, and when full-grown are yellowish white. They feed on various parts of the flower, especially at the base, and further on do harm by feeding on the upper part of the flower-stalk, and the outside of the seed-pods. Soon afterwards the grubs fall to the ground, bury themselves, and turn to chrysalids in the ground. This attack appears to me to rank

in destructive power next after the true Mustard Beetles, and to be very often not distinguished from it.*

With regard to these, the *Phadon betulæ*, as I am not aware of the method of deposit of the eggs, and hatching out of the larvæ, being generally known, I add the following details from my own observations.

On the 2nd of June, a very good supply of Mustard leaves, on which eggs of the Mustard Beetle, *Phadon betula*, had been deposited, were sent me by request of Messrs. J. and J. Colman, of Carrow Works, Norwich, from Littleport Bridge, near Ely, per favour of Mr. Smith Flanders, for examination as to possible effects on the eggs of a dressing which had been applied five days before. The leaves were sent me tied up in two bunches, one bunch consisting of the leaves which had been dressed, the other bunch (duly distinguished and sent for comparison of condition of the eggs) of leaves to which no dressing had been applied.

These leaves I placed with the tips of their stalks in water, in a room of ordinary temperature, but two days later (on June 5th), as the eggs were unaltered in appearance, I moved the leaves to a room with a south aspect, where a window was open close to them during most of the day.

The eggs were smooth, cylindrical, and blunt at the ends, and yellow in colour; and for the most part were placed longitudinally by the side of the mid-vein, or one of the side veins, on the back of the leaf. They were very rarely indeed not placed by a vein, and (as far as I saw) never on the upper side of the leaves. They were placed in a little hollowed-out space, so that the egg rested in the substance of the leaf, against the inside of the upper skin of the leaf, and they were usually (although not invariably) covered by what appeared to be dead and discoloured remains of the skin of the little patch of hollowed-out leafage in which they rested, but, any way, by some adherent and protective rubbish.

The eggs appeared to be in healthy condition, that is, bright, shiny, and plump (not shrivelled or discoloured) when I examined them shortly after receipt, but I could not find as yet any formation of the larva, or grub, then taking place within, excepting perhaps in a few instances, and on pricking them a yellow fluid ran out; it was not until the 7th of June that they began to hatch, and on the following day I was able to watch the emergence of the larva, and its changes of colour, in detail.

The shape and colour of the egg could now often be seen through

* The above note on the "Turnip-flower Beetle," as well as that on the "Mustard Beetle," I have given nearly verbatim from my leaflet above mentioned, of which I should be happy to offer copies to any applicant.—(E. A. O.)

the thin film of the upper coat of the leaf, which had been left remaining untouched when the egg was inserted from the other side in the little cavity formed for it, and this upper film was now in some instances beginning to split away.

The operation of hatching, or emergence of the grub from the egg, was very slowly performed. In the case of a larva which I observed in the act of coming out of the egg, and which was then about three-quarters emerged, it was precisely nineteen minutes before the operation was completed, and the little grub stood beside the empty egg. During hatching the grub was not of the smoky colour which it presently acquires, but of a bright orange-yellow, with the four black spots on the back of the second and third segments from the head showing very noticeably on the yellow ground colour. The colour gradually became duller, changing to dusky or smoky tints of orange or yellow, and about forty minutes after the time of its first appearance from the egg, the little black horns were observable, and the head and claw-feet were turning grey, and the larva was now able to move about readily, making use of its caudal sucker-foot to help it in progression. The other larvæ, which I was able to watch during or immediately after hatching, were similarly of an orange colour, and changed gradually to the first shades of the smoky grey colour, under which we know them only too well on the Mustard leafage.

The above-mentioned method of egg deposit, and then of covering over of the eggs by the Mustard Beetle, is worth notice, as in the first part we see how early in the attack (even before the maggots have hatched out of the egg) the health of the leafage is damaged by the preparations for their presence; and next that the covering placed over their eggs acts as a protection to them from the effects of the remedial dressings which we might otherwise have hoped would help to check the attack in embryo.

The plentiful supply of grubs which hatched from the eggs enabled me to experiment on the effect of "Paris-green" applied to them as a dry dusting, with the result that nearly all so dusted were dead on the following morning.

On June 9th, I chose a Mustard leaf infested by a large number of the Mustard Beetle larvæ, which had begun to hatch on it two or three days before. This I dusted as lightly as I could with Paris-green by holding the leaf upright, and throwing a little of the powder taken up between my fingers and thumb at it, so that the under side of the leaf, on which the maggots were dispersed, was for the most part just faintly or hardly perceptibly tinted by it. In a few parts only there was a little patch where the powder was noticeable. This was a little before 6 p.m., and on the following morning, on examination of what had resulted at 9 a.m., I found that, with the exception of three of the

grubs, all that had been hatched when the Paris-green was powdered on the leaf were dead. Of these, fourteen were still adhering to the leaf, others had fallen on to the saucer, and some into the film of water in which the tip of the stem of the Mustard leaf had been placed to keep it fresh so that there might be no question as to the larvæ not dying from want of food, rather than poisoning. Altogether the quantity killed as above was about eight and forty.

As the foregoing notes refer to specimens placed in my hand relatively to the early stages of attack, and also to experiment, which the liberal supply of material enabled me to carry out, I have placed these together before entering on the reports or correspondence of the season.

Much correspondence took place in January; and on the 1st of February, Mr. H. L. Leonard, of Preston, Hull, forwarded me the following report of discussion of the subject at a meeting which he had recently attended, and which embodies many points useful for consideration or amplification, and therefore (with permission) I give it *in extenso*, excepting a few sentences not especially bearing on the business points of the matter:—

“I last week went to Peterboro’ to a conference of the Cambridge-shire farmers *re* Mustard Beetle.” . . . “They agree that the beetle comes out of its winter retreat as soon as the sun gets well out, that it goes to the young Mustard plant, and lives on the leaves; it lays its eggs under the leaf, the grub is then hatched and falls to the ground,* where it buries itself, and goes into the chrysalis state. The beetle then emerges, and attacks the plant again.

“They all agree that the seed must be drilled further apart in the rows, and *constantly* worked amongst by the *horse hoe*, which will turn up the chrysalids, and which the birds would eat. One grower has always drilled the rows two feet apart; he pays great attention, and is confident that when the beetle is knocked off the plant it will remain on the ground for days if it is sunny. The first dull day, however, they return to the plant. If this is really so, it is a very important matter. As a dressing with the Strawsonizer he has used paraffin and water in *equal* parts, which was very effective, and which did not injure the plant. I did not agree with this being my opinion on syringing my plants, but he assured me that he was correct, and said there was great difference between a syringe which would leave the liquid in drops, and a Strawsonizer which would leave simply a dew on the leaf. †

* Mention is omitted here of the feeding of the grub intermediately between the date of hatching and when full-fed going down for the change to chrysalis state; this being known to all present, would obviously not need entering on.

† This is a very important difference, but does not necessarily need a “Strawsonizer” to carry it out. There are other different kinds of sprayers which will give the dew-like deposit.

“Mr. Young said he strongly supported Miss Ormerod in all her theories on the beetle. Said he top-dressed his Mustard with fish-bone manure, which drove off all the beetles, and they did not return till after rain came, which washed off the strong smell. This year the same gentleman is going to lay ridging tiles all round a field which he will sow with Mustard, and cover them with tar continuously. He knows the field is clear of beetle at present.

“Another grower said he had always found it better to sow Mustard seed where the beetle had been very numerous in the previous Mustard crop, than on a field which had not been previously infested. He had tried an experiment which he thought might be very advantageous if taken up by an experienced machinist. As I understood his idea, it was something like a large well-hollowed shovel on wheels, exactly the width between the rows, just touching the plant at either side; it is pushed on by a man, and the beetles drop into the shovel alive, and can then be burnt. This is very simple, and I think the idea could be worked out to great advantage.*

“All growers are agreed that tar is very much objected to by the beetle. One farmer noticed myriads of beetles crossing the road, and through the gateway into his Mustard field. He divided about an acre against the gate from the rest of the field with a broad streak of tar; every night he renewed the application, and saved all his crop, excepting where the beetles were, which of course was completely destroyed.

“Another large grower thinks the Mustard Beetle in *the early growth* of the plant is blamed for more than it does. He thinks that the ordinary Turnip Fly does an immense amount of damage.”—(H. L. L.)

This is a very important point, to which it seems to me sufficient consideration is not generally given. Whilst forming my Report on Mustard Beetle for the Royal Agricultural Society in 1886, I received notes from various correspondents of the injury done to Mustard in the first growth by Turnip Fly, or Flea Beetle. Specimens were sent of the beetles, and of injured leafage, and the infestation was described as “a great trouble by eating the plant when it first comes up.” Also, “scarcely a plant remains of the original sowing”; and again, another correspondent, who forwarded three different kinds of Flea Beetles, mentioned them as destroying the Mustard on that part of the field where the seed-bed was not properly prepared; but that they were not to be found elsewhere.

For this kind of attack probably Fisher Hobb's mixture, which is so serviceable as a remedy for Turnip Flea Beetle on young Turnips, would be

* If no more efficient plan is made public before requirements of protection come round again, or if brought forward the implement should be too expensive for ordinary private purchase, it is to be hoped that the suggester of the above will have it worked into serviceable form.—Ed.

equally useful. This consists of one bushel of quick-lime, and one of gas-lime, six pounds of sulphur, and ten pounds of soot, well powdered and mixed together, and applied WHEN THE DEW IS ON. The above amount is sufficient to dress about two acres of young Turnips,—the precise quantity needed would depend on size of plant, and distance between the rows.—Ed.

Mr. Leonard continued his report of the discussion as follows:—

“It was generally agreed that the most damage is done the fortnight before cutting the crop, when it is not possible to get amongst it. It is therefore of the greatest importance that the first lot of beetles in the spring be destroyed as much as possible.

“It was also agreed that the beetle prefers white Mustard to brown, and then Rape after the brown. One grower says that the beetle will lay its eggs on Mustard, and a few on Rape; but that though it may feed on Swede Turnips, it will not breed there. If there is no Mustard or Rape in a district, the beetle will die out, because no eggs will be laid. Most growers were agreed that the best thing to do would be to cease growing Mustard seed in badly infested districts; but it was found to be impossible to get the farmers all of one mind. One grower suggested that Messrs. Colman & Keen should refuse to buy seed from an infested district for five years, but it was pointed out that there was nothing to prevent speculators from buying it.

“It was not thought that many beetles remained in the straw. From the evidence, it strikes me that the most important thing to do is to gather up and burn the stubble, into which nearly all the beetles collect after the crop is cleared. As the stubble is green for some time after cutting, it would not break off by being rolled, and I cannot see how it could be done otherwise; it would not burn as it stands in the ground. A grass reaper might probably cut up a good lot, but not all.”—(Signed H. L. LEONARD.)

Some other observations bearing more generally on prevention of attack were added, and also a few enquiries, to which I replied at the time; but it will be seen that the above notes give many points of serviceable interest, both for present information, and as leading to further enquiry.

Consultations were held, and suggestions and leaflets issued, and arrangements made in various quarters for field experiment as to practicable means of getting rid of the Mustard Beetle; but so far as appears from reports received, weather or other circumstances so influenced amount of this special pest, that though it (the *Phædon betulæ*), and its ally in causing damage, the Flower Beetle, did mischief in various places, there was not the sweeping devastation which in some years makes those interested willing to try any reasonable plan of remedy.

Later on the beetles appeared in vast numbers in one district. On the 23rd of September, Mr. Leonard wrote me again as follows:—"I am able to say now that there are an immense quantity of beetles in the Holderness district, and yet with the exception of about half an acre in one field, and the headland in another, which are completely destroyed, I cannot find any damage is done." Very possibly there may be opportunity in this greatly infested district for experiment next year; but at present, that is, in the past season, we do not seem to have made advance, at least to any notable and publicly announced extent, in knowledge of benefit from dressings, washes, and the like. Some of the soft-soap mixtures, which, from their success on very similar attacks, I had hoped might be of use, turned out, though tried with much care, a total failure.

With regard to preventive treatment, or to treatment calculated to push the crop on, and support it when attack is not absolutely overwhelming, it seems to me but a due respect to our Mustard growers to point out that a very large proportion of the really sound and valuable information now dispersed in leaflets, pamphlets, &c., was originally, and not long ago, *contributed by themselves*. In 1886, when attention was especially directed to the losses occurring from attack of Mustard Beetle, information was requested by the Council of the Royal Agricultural Society, and, as being then entomologist of the Society, I received much communication, which I formed into a Report printed in abstract in the 'Journal' of the Royal Agricultural Society, 1887, and in full in my own 'Annual Report of Observations of Injurious Insects' for 1886.

In these Reports will be found the first-rate information given by our leading Mustard growers themselves, as the result of their long experience, on such points as winter-locality of the pests, also the treatment of ground to start and keep up good growth, manures found especially effective, and many other points bearing both on the habits of the beetles, and agricultural points to be attended to, and also the *very little* benefit that was found to be derived from dressings was entered on.

For those who have not access to the information *in extenso*, the very excellent four-page leaflet, or circular, issued by Messrs. Colman, of the Carrow Works, Norwich, may be strongly recommended as embodying, in condensed form, an enormous amount of sound information, and also much useful suggestion, amongst which are some serviceable observations on drilling Mustard twelve to twenty-four inches wide, so that the ground can be horse-hoed so long as the hoe can be taken through the crop without damage. Thus besides other good effects, many of the beetles can be knocked off, and the chrysalids thrown open in the disturbed ground to be preyed on by birds. Also dressings

which otherwise could not be applied, may thus be thrown on the crop without injury to it by breaking it down.

This is such a very important consideration that it deserves special notice, for in 1886, when through the courtesy of the late Prof. Herbert Little, of Coldham Hall, Wisbech, and Mr. William Little, of Stag's Holt, March, I had the opportunity of personally examining some of the Cambridgeshire Mustard crops relatively to feasible methods of clearing the beetle, the closeness of the Mustard plants was considered to make such measures impracticable.

The circular of Messrs. Colman includes also some serviceable observations on the "Flower Beetle" (the *Meligethes aeneus*), together with figures of this and the common Mustard Beetle. The circular was largely distributed gratuitously last spring, and probably would be obtainable still through the courtesy of Messrs. Colman on application to themselves.*

During the past season, a really surprising number of mixtures, or powders for dressings, and sprayings to be applied by various forms of implements, were suggested for experiment, but of most of these (if tried) we still need to know results. Some, as mentioned above, were tried and failed. One class of application, however, I should myself have great hope would be successful, namely, Paris-green. In such limited and mere laboratory experiment as I was able to try myself (see p. 65), it answered excellently in poisoning the Mustard Beetle grubs, and from the very near relationship of our Mustard Beetle to the Colorado Beetle of America (both being Chrysomelidæ), there would appear to be every reason to hope that Paris-green, which has so long been a general accepted method in America of clearing the Colorado Potato Beetle, should be equally serviceable here.

But whatever might or might not occur as to possibility of clearing the Mustard Beetles by application of dressings, a very important advance towards a method of keeping them in check was made last season in the invention, by Mr. Cole Ambrose, of Stuntney Hall, near Ely, of a machine suitable for field use, which proved on trial excellently successful.

Of this, Mr. H. L. Leonard, of Hull, who, with other gentlemen personally interested in Mustard growing, or connected with our chief Mustard manufacturing firms, were present at a field trial of the machine,

* 'The Mustard Beetle,' a four-page circular issued by Messrs. J. and J. Colman, 108, Cannon Street, London, E.C.; and Carrow Works, Norwich. Coincidentally with Messrs. Colman's circular, I also issued a four-page leaflet, of which I should be happy to send copies gratuitously to any applicant. But this was on a much smaller scale, being more especially intended to place figures of the four common Mustard pests (given above at pp. 60—62) in the hands of those who might have difficulty in distinguishing the different kinds of insects.

wrote me as follows regarding the apparatus as it then was. Since then gradual alterations and improvements have been made, especially in the arrangements for brushing the plant, which I can say from my own personal examination of the details of the machine must add much to its efficiency.

Mr. H. L. Leonard wrote me on the 17th of August:—"Through the kindness of the inventor, Mr. Cole Ambrose, Stuntney Hall, Ely, I was permitted to witness the working of a machine for catching the Mustard Beetles. I should describe the framework as similar to that of a horse-rake without the teeth; from the top bar hang five shallow pans about two feet six inches long, two inches deep, and made the same width as the Mustard seed rows are drilled apart. The pans just clear the ground, and in each is placed about an inch of common tar. Some light pieces of wood are so placed that they lightly brush the plant as the machine moves along, and almost every beetle drops into the tar and perishes.

"Nothing could be more successful in its work than this beetle-catcher; it is so very simple that it cannot get out of order, a pony pulls it, a man and a boy are sufficient to go with it; it goes over about twenty acres a day, and it does not injure the plant in any way, even when it is coming into flower.

"It has not been in the hands of the general public yet; but Mr. Cole Ambrose has two hundred acres of beautiful Mustard seed, whilst his neighbours have had their crop destroyed. The machine catches the *Phædon betulae* and the *Meligethes æneus* equally well."—(H. L. L.)

The following report of his views as to the serviceableness of this beetle clearing machine was also sent me by Mr. James Egar, of The Rookery, Guyhirn, Wisbech, on the 8th of August:—"MUSTARD BEETLE.—A machine has been invented, and very successful for collecting them, by Mr. Cole Ambrose, Ely. I was invited by Messrs. Keen & Co., Mustard crushers, to inspect it at work on Mr. Ambrose's farm, and found it work admirably. Very efficient in its collection of the pest; it proved itself so in two ways,—leaving no beetles on the Mustard, and almost an innumerable lot on the emptying places at end of field."

About a week later, Mr. Egar wrote further:—"The invention I mentioned for taking the Mustard Beetle, I am confident is a very valuable machine"; and Mr. Egar further noted, amongst observation of the examiners of the trial operations:—"Firstly, of the presence of the beetles on the Mustard; then of the thorough clearance of the beetles from the crop; and thirdly, the 'immense number' found in the composition for catching them."

On the 22nd of November, Mr. Ambrose, as I was not able conveniently to go over to Ely to examine the machine, was good enough

to bring over a sample of an improved form in pieces, and have it put together for my inspection here.

This operation only occupied about an hour and a quarter. The moving power and framework of the machine consists of a single pair of wheels (on which the machine rests), with what may be described as two small pairs of shafts, or large handles, one pair pointing forwards, and another backwards, joined in the middle by a frame, *across* which are fixed two long bars.

It is difficult to convey an idea of machinery by simple description, but if the reader will imagine a frame made on the general plan of a garden hand carrying barrow, with its handles behind and before, and instead of the carrying boards in the middle, the centre crossed by two light bars about seven feet long, and this frame supported on a pair of wheels; this will give (excepting in the machine being much larger than the barrow) a general idea of the frame from which the beetle clearing apparatus is suspended.

This part consists of five flat metal troughs, twelve inches wide, four feet long, and about two inches deep, slung from the cross-bars, so as to hang about six, or rather more, inches from the ground, and of course ranging from back to front (*i. e.*, not cross-wise). When in use, a layer of tar is placed in these troughs. On either side of each trough, and hanging from above, so that the lower edge is rather above it, a piece of canvas, somewhat longer than the trough, and a yard deep, is lightly slung (by a wand run in its upper edge) to the cross-bars.

The method of action is for the machine, which is very light, to be drawn or pushed along the rows of infested Mustard. One long trough passes between two rows, and the canvas on each side passes along with it *outside* the two rows, the apparatus being so contrived that the light touch of the canvas does not injure the plants, but very gently bends them a little over the trough below, into which the beetles fall in legions, and are caught by the tar. The machine is made for the suspending horizontal frame to range about four feet from the ground, but it is furnished with upright screw standards, by which it can be raised to allow a crop at ordinary full growth to be cleared. One important part of the arrangement is the slinging of the apparatus, which is so managed by short chains that no force is used; the strips of hanging canvas are in constant vibration, thus very lightly shaking the plants, but not *weighting* them, as their own light weight is slung from the bars. Each trough, with its shaking-off canvases, takes two rows of Mustard, consequently the machine with five parallel troughs would clear ten rows of Mustard simultaneously, and it will clear from sixteen to twenty acres in the course of the day.

The main alterations of the machine since the inspection in August,

consist in it being so arranged that it is not necessary for it to be drawn by a pony, which might probably cause a good many beetles to be knocked off before the sweeping and catching apparatus reached them, and also, I believe, the shaking-down arrangements were not then as complete. On flat ground, without obstructions, the machine was very readily pushed along rapidly by one man, and where greater power is needed (with the double shafts), it can be arranged for accordingly. On reaching the ends of the Mustard rows, the machine being very light can (as I saw) easily be lifted by two men, moved on to the next width of rows to be dressed, and work recommenced, without any need to turn it, as it works similarly either way forward.

In thus drawing attention in long detail to this new invention, I should perhaps add that I am doing it by desire of some of our leading Mustard growers, and also with the full permission of Mr. Ambrose; but I should also mention that though giving the principle of action, and enough description to show its usefulness, I have (or at least I hope I have) in no way entered on details which would make this a means of copying the machine to the injury of its *inventor and proprietor*. Its *effectiveness* and its *safe* action on the crop depend on minute adaptations, causing special movements which I have purposely omitted entering on.

In this machine I think we have the broadscale application of the plan long ago brought forward in Germany of clearing the beetles by manual labour, which has been acted on here to some degree, but as far as I am aware very rarely, on account of the great expense, and also the tedious delay of the operation. The only difficulty that occurs to me in the general application of the machine, is the necessity that the Mustard should be a drilled, *not* a broad-casted, crop. But this would be only an occasional difficulty.

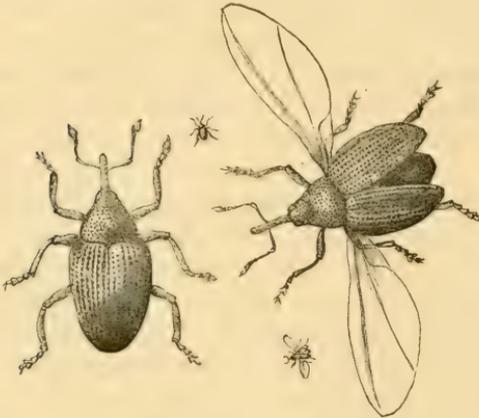
Also in its working application it is to be remembered that its use is to get rid of the *beetles*. It will equally well clear the Mustard Beetles, or the Flower Beetles (which are not far behind them in the mischief which they cause), and if this is done in time, the damage going forward by the beetle action will be put a stop to, and also we shall be saved from the next attack, which would have originated from the grubs hatched from the eggs these beetles would have laid. But if the attack should not be taken in time, though we should get rid of beetles, very likely much of their supply of eggs would have been laid, and their results would in due season ravage as usual.

In this machine I believe, partly from my own inspection of it, partly from the reports sent me by known Mustard growers, and also partly from it working forward on a field-scale-treatment which we knew was good, but could not work forward by hand labour on account of its great expense, that we have a good working remedy.

Doubtless amount of attack might be lessened by preventive measures, but everybody who is really acquainted with farming will know how little likely it is that money will be spent, and farm service taken up in preparations for an infestation which it is just as likely as not might not be going to occur in the next season.

What we want here (as in many other attacks) is something on the farm, or at hand for a neighbourhood, which may be put in working order in a few hours or less when the pest is really seen to be on the crop, and which may be trusted to clear it at once, without damage to the plant, and, as far as I can form an opinion on the matter, in this machine we have it.

Charlock Weevil.* *Ceutorhynchus contractus*, Marsh.



CEUTORHYNCHUS CONTRACTUS.—In usual position, and also with wings expanded, magnified; also nat. size.

The little weevil figured above did a great deal of harm early in last season to the young sprouting Mustard plants by preying on the germinating seed, or on the young plant just below the surface of the ground.

This *Ceutorhynchus contractus* is very like the well-known Turnip-gall Weevil, also the Seed Weevil figured at p. 62; like them it is of a hard rounded general figure, blunt behind, and tapering before into a long curved proboscis, or snout, on the sides of which the elbowed

* I am not aware of this little beetle being known under any generally accepted English name, but in the Index to Curtis' 'Farm Insects,' at p. 519, there is a single reference to it as the "Charlock-seed Weevil." Therefore, as the name of "Charlock Weevil" would include the root-galls (from which we have scientific record of this weevil being bred) as well as other parts of the plants, I have thought this name conveniently admissible.

antennæ, or horns, are placed. It may, however, be to some degree distinguished from these by its smaller size, this being only about half to three-quarters of a line in length, whilst the stated length of the Turnip-gall Weevil is one line and a third, and that of the Seed Weevil from one line to a line and a quarter. The general tint is shiny black; the wing-cases sometimes (and in some of the specimens before me) having a very slight greenish glance, and the fore body, or thorax, which is narrowed (and crossed by a deep groove) at the end nearest the head, is strongly punctured above. The wings are so finely nerved that even with a two-inch objective, I could only distinguish those figured.

On the 10th of May, Mr. H. L. Leonard, of Preston, Hull, with whom I had been in correspondence for some months previously on the subject of Mustard attacks, was good enough to forward me the following report of his personal observations of the mischief then being caused by the ravages of this little beetle:—"I have just finished my round amongst the Holderness growers of white Mustard seed. I find a great amount of damage has been done by a small weevil, which is present in immense numbers, and of which I send you specimens. Owing to the heavy rain on March 1st, and the subsequent long drought, the soil is in small clods, instead of being, as should be the case, well pulverised, yet firm.

"Just before the plant shows itself above ground, the weevil (which through the unusual state of the soil is enabled to run under the surface easily) eats the seed, and in doing so of course destroys the young plant itself, nothing being left but the thin sprout, which quickly dies. Virtually, every seed is destroyed in some fields, and they have had to be sown over again. As a proof that the weevil would probably be innocuous but for the exceptional condition of the soil, I notice that in the worst infested fields, when a piece of land is in fine condition, you find the plant upon it quite healthy, and growing well.

"On some fields the plant has been eaten off after it appears above ground, but in all these cases the plant *was delicate and growing badly*, and *both the weevil and the Turnip Fly* were present in large numbers. The farmers generally think the weevil the most destructive of the two." Later on (Mr. Leonard mentioned), "The weevil completely disappeared in about three weeks or a month."

On June 7th, Mr. Leonard again alluded to the great extent to which he found amount of attack was influenced by condition of the land, and consequent condition of the plants "wherever the land had worked more freely, and the Mustard was growing more vigorously, there you scarcely find any of the weevil. The more delicate the plant, the greater the number of insects.

"Several of the farmers are quite certain that where the plant was eaten off above ground, the damage was done by this same weevil. I

enclose you some live specimens of the weevil, and also some sprouts which have been eaten in the ground; I am afraid the latter will be too shrivelled to be of any service to you."

The little seedling plants were too shrivelled to be useful for figuring, but they well confirmed Mr. Leonard's account of the damage caused to the very young plants by being gnawed by the weevils, and the plentiful supply of the weevils, sent accompanying, gave me material for the figures at the head of this paper.

In the course of his communications, Mr. Leonard mentioned that a large quantity of seed had passed through his hands in the spring, but he had not seen one weevil amongst it; and, after the great ravage alluded to above, this *C. contractus*, sometimes known formerly as the "Charlock-seed Weevil," appears to have entirely vanished. On the 5th of August, Mr. Leonard, in continuation of his observations, noted:—"The weevil, as I reported, did a great deal of damage where the plant was checked in its growth by drought, and in several fields, where the same insect had eaten off the young plant just under the surface, the crop had to be sown over again; but in no case have I had it reported to me that the weevil appeared a second time; in fact, the second sowing of Mustard seed looks very well.

"The weevil seemed entirely to disappear in a few days, *during which we had no rain*. I was asked to examine a field which was very badly infested; ten days afterwards I could not find a single specimen."

On the 11th of November, Mr. Leonard further noted:—"Our second sowing of Mustard seed has done fairly well, and in *no case* has any perceptible damage been done to it by the weevil, in fact I have never noticed one since the first attack."

Some notes sent me on the 26th of May, by Mr. Edmund Riley, of The Weir, Hessle, Hull, obviously refer to this *Ceutorhynchus contractus* presence:—"I was in Hull on Tuesday; several of the Sunk Island farmers complain bitterly about something eating their Mustard just before it comes up, that is, as soon as it has burst through the skin; the two delicate leaves are eaten, and the seedling dies."

The only previous occasion recorded (so far as I am aware of) of this weevil doing serious damage was in 1881, the year memorable for the great Turnip Flea Beetle attack, which was little less than a scourge over a great part of England and Scotland. In that year this *Ceutorhynchus contractus* (the Charlock or Charlock-seed Weevil) was reported as doing much damage to young Turnips in their first growth, and also (which may be an important point in its habits for preventive service) when the Turnips were cleared, going on to Charlock, sometimes known in Scotland as "Runches," or "Skellocks," and scientifically as the *Sinapis arvensis*, Linn. The method of injury was of much

the same kind which has been observed in the past season on the Mustard, the plant being in some cases "destroyed by the weevil nipping the stem through just below the seed leaves as they were pushing up out of the earth." In another instance (where the first sowing of young Turnips, and then the Charlock, had been cleared by the weevils) resowing "was begun on the 17th of June by passing the Turnip sower over the drills, the ground being clean and mellow; the plants came up rapidly, and just as they were coming through they were again attacked by the weevils, the leaves being literally blackened by the numbers of the insects, the parts of the field where the Charlock was most abundant during the preceding season being the first to fail before the attack, and being soon cleared; and from these spots the weevils gradually extended their ravages, and again ruined the crop."*

The weevils in these attacks did not limit their ravages to damage to the sprouting plant, but if it survived (or chanced to escape) infestation up to production of seed-leaves, these were severely injured or destroyed, "the weevil puncturing the leaves partly through, both from above and below, so badly, that on one seed-leaf, taken as an example of the many," I found, on examination, "there were twenty-two punctures (not perforations) on the upper side, and about sixteen on the lower." In the ten days preceding the 8th of June it was more injurious even than the Turnip Fly, and hundreds of acres are reported as having been destroyed by it; dry weather occurring at the time in the district round Earlston (Berwickshire). These were resown with a double quantity of seed, and the insects reappearing, a second clearance was feared; but a good rain set in, and the plants came away well.†

The above attacks took place in coincidence with circumstances to check the growth of the young plants, as drought and heat, in one case noted as "intense heat" from the 22nd of May to the 4th of June, this heat being followed by frosty nights, accompanied by cold winds, which checked the plants to a serious extent, and in some instances completely destroyed them.

The above observations of the injury caused to leafage corresponds with the note given in 'Introduction to Entomology,' by Kirby and Spence, p. 188 of vol. i. of 3rd edition, as to "almost as much damage being sometimes occasioned by a little weevil, *Curculio*" (= *Ceutorhynchus*) "*contractus*, which in the same manner pierces a hole in the cuticle," as by the Turnip Flea Beetle.

* 'Report of Observations of Injurious Insects for 1881,' by Eleanor A. Ormerod pp. 103—105.

† See Report previously quoted.

This Curtis confirms in his 'Farm Insects,' p. 106, on the authority also of other observers named, noting, "This little weevil in the perfect or beetle state destroys the young Turnips by puncturing the leaves."

But though we have plenty of evidence, dating as far back of the damage caused from time to time by these little weevils, the *Curculio*, now *Ceutorhynchus*, of Marsham, both to the sprouting shoot and young leafage of Turnips, and in the past season have seen only too much of the harm caused to the sprouting Mustard plants, yet I have been unable, after careful search through all the works to which I have access on entomology, or agricultural insects attacks, to find any observations on its locality of life in its maggot stage excepting the very valuable record by Kirby and Spence of breeding it from galls on Charlock roots.

At p. 189 of 'Introduction to Entomology,' vol. i., previously quoted, Kirby and Spence speak definitely of knobs on the roots of *Sinapis arvensis* (that is, Charlock, as we commonly call it in England), from which knobs they bred this weevil, now known as *Ceutorhynchus contractus*. Curtis, in 'Farm Insects,' p. 106, draws attention to this observation; and in the north British communications sent me in 1881, I have a note in the observations of Mr. Geo. Brown, of Watten Mains, Caithness, of "the crop of Oats preceding the root crop" (which was severely injured by the *C. contractus* weevil) being "badly infested with Charlock, the field at one time being completely yellow with its flowers."

Here it appears as if we might have the origin of the attack. At any rate it would be well worth while in the coming season to make sure how many different species of weevils live in the knobs or galls of Charlock roots. I would be happy to endeavour to identify any specimens.

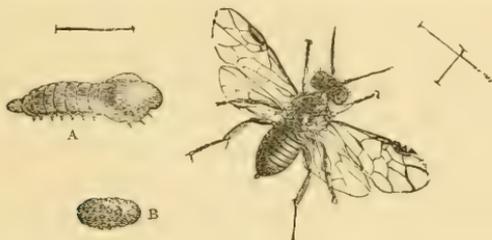
At present (so far as recorded observations at hand show) the prevalence of this special weevil infestation appears to depend very much on how *previous state* of the weather may have influenced preparation of the ground for the seed bed, and weather *at the time* of sprouting of the crop be favourable to its growth. Where the state of the land allows this minute beetle with its sharp hard snout to make its way wherever it pleases, and the weather at the same time keeps back the young plants from pushing on to the age and condition in which they would be past its power to harm them, the consequences are necessarily bad.

Presence of Charlock has also preceded bad attack of this weevil, and the size of its wings (see fig., p. 74) shows the beetle would have no difficulty in coming from any moderate distance to a good feeding-ground.

So far, however, as remedial measures have been tried, the result has been very unsatisfactory. Quick-lime strewed on four infested drills by way of experiment drove away some of the weevils, but "the remedy could not be said to be successful." Soot did little or no good, and hellebore was not reported as of service when used alone, but mixed with lime did the most good of the above applications. It was, however, noticed that where gas-lime had been used in the previous autumn the Turnip plants appeared less infested, and in a few instances got into the rough leaf.

PEAR.

Pear and Cherry Sawfly; "Slugworm." *Selandria atra*, Westwood;
Tenthredo cerasi, Linn. (of Curtis); *Eriocampa limacina*, André.



TENTHREDO CERASI.—"Slugworm" and Sawfly, magnified, with lines showing nat. length; cocoon.

Amongst the various kinds of Sawfly attack which appeared in the past season, that of the larva of the Pear and Cherry Sawfly, commonly known from its very peculiar appearance as the Pear "Slugworm," was perhaps more noticed than usual, and some very characteristic specimens of the grub, both in its commonly observed slimy black condition, and in the subsequent clean yellow caterpillar state, were sent me. Some infested leaves gave me also the opportunity of noticing the earlier part of the attack, when the larva is still within the egg, and thus tracing the changes of appearance on from its first white colour to the pale yellowish tints of the young grubs in their early condition, before they assume the black slimy coating, from which they take their name of "Slugworm."

This infestation is sometimes exceedingly hurtful by the grubs eating away the whole of the upper surface of the leafage on which they feed with the exception of the veins, and sometimes they are very numerous. Often, however, where I have had the opportunity of

observing them, the numbers have been small. This difference in amount is noticed by Mr. Cameron,* who (besides reference to their occasional appearance in great numbers, "as they unfortunately too often do") writes of their more ordinary infestation as follows:—"The larvæ feed on the upper side of the leaf, usually to the number of three or four. They eat only the upper epidermis; at first the leaf gets eaten in patches, but ultimately every particle of green is devoured, so that it has the appearance of having been scorched, and ultimately it falls to the ground." . . . "The damage done by these ugly brutes to fruit trees is very often immense; especially is this the case during very dry seasons. They are found on most species of *Pyrus*, *Prunus*, *Cerasus*, *Rubus*, and *Amygdalus*, as well as *Cratægus*, *Quercus*, and *Betula*."—(P. C.)

Of the above list, the three first, the Pear, Plum, and Cherry, are the most important for garden consideration, and it has never chanced to me to meet with them on the three last named, the Hawthorn, Oak, and Birch.

The grubs are, in the greater part of their lives, of the shape figured at p. 79, that is, both broader and thicker at the fore part of the body, and altogether somewhat pear-shaped, but covered with a shiny blackish slime, or exudation, which gives a strong resemblance to a little black Slug, or perhaps still more to a bit of wet black dirt fallen on the leaf. At the last moult the grubs throw off the black slimy coat, and appear as yellowish caterpillars transversely wrinkled. After this change they soon go down into the ground, where they spin small black or brown cocoons, from which (in ordinary course) the Sawflies come out early in the following summer.

The flies are of the shape figured at p. 79, black, shining, the female sometimes tinged with violet; the "wings hyaline, with a broad smoky band in the middle."

The first communication of last season regarding Slugworms was sent me on the 14th of June, from Neasham Hill, Darlington, by Mr. R. Cresswell Ward, with some Pear leaves accompanying, which gave me the opportunity of observing the young Sawfly maggot whilst still in the egg. Mr. Ward wrote:—"Can you tell me what is the insect enclosed? It appears to me to be a kind of black Slug. For the past three years it has come on my Pear trees about this time of year. It eats all the upper skin off the leaf, which turns brown and drops off; all the strength appears to go from the trees, which have hardly fruited since it began. I tried syringing with paraffin, water, also soap-suds, last year, and this year my gardener painted the stems and

* See 'Mon. of the Brit. Phytophagous Hymenoptera,' by Peter Cameron, vol. i., p. 225. (Ray Society).

boughs with a mixture of sulphur, paraffin, soot, and gishurstine; but it has done no good. Can you suggest any way to stop the attack, both now, and in the future?"

In reply I mentioned the benefit of use of caustic dressings (noted at p. 82), applied twice, or possibly three times, at short intervals, and on June 19th, Mr. Cresswell Ward wrote further regarding effect of the application on the Sawfly larvæ:—"My gardener has used the quick-lime, and it is killing them rapidly; and your other instructions will of course be carried out, and another year I have no doubt the trees will bear fruit." . . . "The heat is very intense; we all hope for rain."

Mr. Ward's note of the heat and drought is of special interest in connection with the information recorded by Mr. P. Cameron (*loc. cit.*, p. 80) of damage being especially great from these larvæ "during very dry seasons."

In this case the active stage of the attack to some of the leaves sent me was only just beginning, the upper surface of the leaf not being as yet stripped of the cuticle in patches, but dotted with little irregularly circular patches, some less than half a line in diameter.

The places of egg deposit were very observable. These were noticeable on the upper side of the leaf as little spots roundish in 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.

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 large segments behind the head, and the hinder portion of the maggot with the segments much narrower. 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 yellowish colour.

The little white blisters, or patches, of white dead skin covering the eggs were about one-sixteenth of an inch across, and 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.

The latest observation sent me of this Pear leaf pest, was sent on the 28th of August, from Etchowe, Lansdown Road, Cheltenham, by Mr. Edward Cornford, and is of special interest as showing the long continuance of the attack.

Mr. Cornford wrote as follows, with specimens also forwarded:—“My Pear trees have been infested this year by larvæ of I know not what.” . . . “They are shiny black, except when they are about to change into the chrysalis state, when they become a dirty yellow.” . . . “The second brood is now *en evidence* about six weeks after the first; I think I have one pupa, but am not sure.”

On the 31st of August, Mr. Cornford wrote further:—“I have not succeeded to any extent in getting many chrysalids, but have one or two which I think have made a sort of cocoon with fine saw-dust. But out of about twenty which I put to burrow when they seemed ripe, I have not as yet found more than two or three in the chrysalid form.” Mr. Cornford further remarked of the grubs, “they are still appearing on the trees, from the smallest to the full-grown size, but the imago I have failed to find.”

This (apparently) second appearance of brood is attributable to irregular date of pupation (*i. e.*, going into chrysalis state of the larvæ) in the preceding year, or to irregular development from this or other cause, of the Sawfly parents during the summer of attack. As a rule, there is only one brood in the year, though the appearance of the grubs, from various causes, may range over a period of three or four months.

A few days later, Mr. Cornford added the further note showing the great amount of the infestation:—“I did not want you to trouble yourself to return the box, &c. I have only too many specimens even now, though my gardener has spent no end of time in clearing, or trying to clear, the trees of the pests. Yesterday I found one specimen on a Plum tree.”

PREVENTION AND REMEDIES.—These are based on two special points in the habits of the larvæ. These grubs, or “Slugworms,” have a power of exuding a coat of slime when annoyed by lime, or other dry dressings, being thrown on them, but they can only repeat this process a few times, therefore if anything like lime, or powdered gas-lime, or a mixture of these is thrown on them, the grub can moult it off *once*, but a second application of it so soon after that the grub has freed itself of the coating, and yet has not had time to re-form the internal supply of slime to protect itself with, will probably completely clear the pests. If more than a few hours are allowed to elapse between the dressings, it is very likely that the second may fail; but if properly managed, two dressings are usually successful.

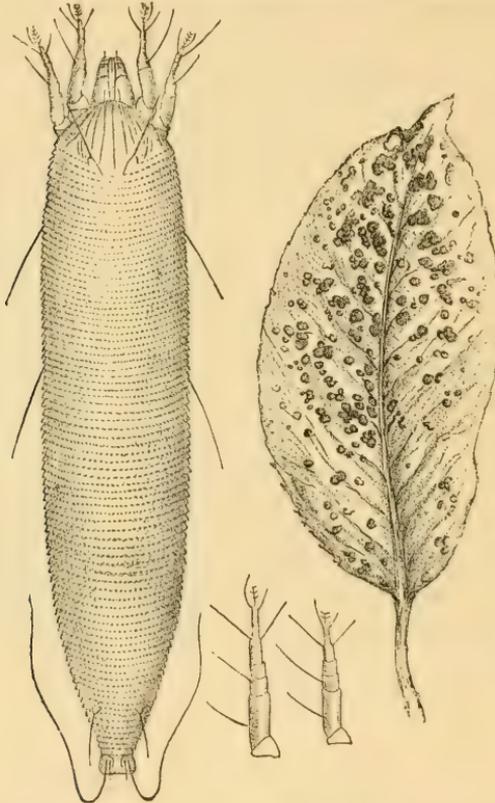
Syringings of the usual insecticides, as soap-suds, soft-soap mixtures, tobacco-water, lime-water, &c., have all been found useful in getting rid of the grubs; so also has shaking down the Sawflies. They have been found to remain for a short time motionless after being shaken off

the tree, and if a time was chosen, as at morning or evening, when the flies were torpid, or collected on the leafage, and they were shaken down on tarred boards, something might thus be done to check mischief.

But besides dusting the grub with caustic powders mentioned above, the surest preventive measure is during winter to skim the surface off the soil beneath trees that have been infested in the summer, and to burn or otherwise destroy it. When the caterpillars are full-fed, they go down into the ground, and there form a little dark coloured cocoon (see fig., p. 79) at a depth of from one to four inches, according to the nature of the soil. With a very little attention, anyone (interested in preserving the crops of Pears) will soon detect the little earthy coloured cocoons containing the caterpillar, or later on, the chrysalis to which it has turned, and from which, if undisturbed, the Sawflies would come out next year. *The ground must not be dug* so as to risk injury to surface rootage, but if lightly forked, or turned in any way which may just disturb the surface only, the cocoons might be hand-picked, or if found to lie close to the surface, this might be skimmed off, and in either way, if the cocoons are destroyed, much good will be done.

All of the above methods of prevention have been entered on in my previous observations of this attack, but as the infestation of the past year gave some amount of additional information beyond what is usually brought forward as to the early life-history of the insect, &c., the whole account would be incomplete if remedial measures were only referred to.

PHYTOPTIDÆ, commonly known as **GALL MITES**.—Pear Leaf-blister Mites. *Phytoptus pyri*, Nalepa; (? *Typhlodromus pyri*, Scheuten; ? *Phytoptus pyri*, Pagenstecker); and other species.



PHYTOPTUS PYRI, female, nat. 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.

During the past year the presence of Mite Galls, that is, of the deformed growth caused by the minute cylindrical four-legged Mites, scientifically known as *Phytopti*, has been more than usually observable. Almost as soon as growth was sufficiently advanced for their formation, we had the red or green nail-like galls on the Maple and Sycamore leaves, and the swelled and stunted leaf-buds, caused by the Mites, on Nut bushes. The Black Currant bud-gall was a bad trouble; and we had besides the blister-like form which injures the substance of Pear leaves, the infestation which raises a kind of wall of little funnel-shaped knobs round the edge of Plum leaves, and the less observable bud-gall of the common Yew.

For many years, the life-history of the minute Mites, which give

rise to the above and to many other forms of gall-growth, and still more their specific description has been (with regard to most of the attacks) a subject of exceeding difficulty. And, further, beyond a very preliminary diagnosis of characteristics, often equally applicable to a large proportion of our most common British *Phytopti*, we were for the most part without any work to turn to, from which (even with the help of the highest microscopic powers) we might trustworthily identify each species in full.

We were in the condition described by Dr. Löw, the eminent Austrian writer on this subject, when he remarked that even if he were to thoroughly examine the mites out of great numbers of the deformed plant-growths which he had described, still he would not be able to give such sufficient and trustworthy characteristics as would supply the power of specific distinction.

In fact (to put it shortly), what even the most scientific "Mite-gall" observers needed was something equivalent to a 'Manual,' containing fully detailed descriptions of the different species of the "Gall-mites," with measurements, magnified figures, and everything requisite for correct and *demonstrably* certain identification.

These now we have in the publications of Dr. Alfred Nalepa, which have been successively issued in the 'Reports of the Proceedings of the Imperial Academy of Science of Vienna.' During the past summer, Dr. Friedrich Thomas, of Ohrdruf, Gotha, himself a well-known phytopathologist, and observer and writer on Gall-growths, did me the favour to introduce me by letter, relatively to study of *Phytopti*, to Dr. Nalepa, then Professor in the Royal Imperial College, Linz-on-the-Danube, now of the Royal and Imperial Government College, Vienna.* Dr. Nalepa was good enough to identify for me all the specimens which I sent over, and also to give me valuable instruction as to the anatomical and structural formation of *Phytopti*.

In the works of which I give some of the titles appended to this paper, will be found a clear and convenient classification of the family *Phytoptidæ* into subfamilies and genera; the main distinctions turning on such points as the body being cylindrical, as is commonly the case with the genus *Phytoptus*, with which we are best acquainted here; or the abdomen being largest immediately behind the thoracic shield, or other variations of form; also on the abdomen being similarly ringed throughout, or with the rings broader on the back and narrower below, or other variations.

With the kind permission of Dr. Nalepa, I have given a copy of one of his very numerous and clearly drawn illustrations at the heading

* Prof. an der K. K. Lehrer-Bildungsanstalt, Linz-u-Donau, Austria; now of K. K. Staats-gymnasium, Vienna.

of this paper, by which the observer will see the cylindrical form, also the position of the bristles and the clearly-defined form of the legs, showing the distinct joints, and the characteristic subterminal feather-formed holding-claw (Haftklaue, Landois).*

For distinction of species, such characteristics as the form, and comparative length and breadth of body; form of thoracic shield; form, direction, and length of proboscis; characteristics of legs, and number of branches of the feather-claw; length, &c., of bristles, and length and breadth of developed males and females; are some of the points given. Very much more besides is clearly entered on, as for instance the change in form of the male of the Nut *Phytoptus* (*P. avel-lanae*) at the time of sexual development, and the apparatus of reproduction is especially entered on, with measures and descriptions; the form of the egg is also given where known. Synonyms, or what might be synonyms if the names referred to had been accompanied by full description, are given; but as it is pointed out, names without full descriptions accompanying are unserviceable. In fact, "bare words" are, as was well said by Dr. Amerling, "of only temporary use as a means of reference, pending fuller description."

In the following pages I give (with permission) some abridged technical descriptions; but as it is hardly just and fair to the author of a work of such depth of research to place mere fragments of it before scientific readers, in translation and in abridged form, I append to the account of the Plum-leaf *Phytoptus* a copy in full of Dr. Nalepa's description, as an example of his careful and thorough method of dealing with his subject. Also I should be to blame if I did not tender my especial and hearty thanks for the kindness with which he aided me by his clear instructions in this difficult study.

PEAR-LEAF BLISTER-GALLS (*Phytoptus pyri*, Nalepa).—"Body cylindrical, about 5-6 times as long as broad. Thoracic shield very small, semicircular." . . . "The proboscis is strong, slightly curved, directed forward, and 0.025 mm. long. The legs are rather weak and short, but distinctly jointed. The bristles are very fine and short. The holding-claw ('Haftklaue') is very small, exceedingly slender, and four-branched." (This is sometimes described as a "feather-bristle"; see figs. of terminal four-branched claw, p. 84.—E. A. O.) . . . "The abdomen is uniformly ringed (about eighty rings), and rather finely punctate." . . . "The above-named species produces on the leaves of the *Pirus communis*, L., numerous pustule-formed swellings, somewhat raised on both sides of the leaf, smooth, at first green, afterwards

* For full description of *Phytopti*,—male, female, and eggs,—see 'Beitrag z. Syst. d. Phyt., in: Sitzgsb. d. Kais. Akad. d. Wiss. in Wien,' 1889. Bd. 981 (separate impression), pp. 8-10.

turning browner." (? *Typhlodromus pyri*, Scheuten; ? *Phytoptus pyri*, Pagenstecker.)*

This Pear-leaf infestation is not often enquired about, but personally, for at least about sixteen years or more, I have never needed specimens without being able to find them in my own garden, and probably if attention was directed to the nature of the attack, a good deal of damage, of which the cause is not suspected, might be spared.

In the course of last year I had enquiries about this attack from various correspondents, but as these did not add to our information on the subject it is unnecessary to give them here.

Under various synonyms the infestation is widespread, both in the Old and New World; and the following notes, from the very trustworthy hand of Mr. James Fletcher, Dominion Entomologist, Ottawa, Canada, recently published, appear to me to embody in serviceable form almost all that we need to know of its history.

"PEAR-LEAF BLISTER MITE, *Phytoptus pyri*. An insect which is giving a considerable amount of trouble in Canada at the present time is the Pear-leaf Blister Mite." . . . "The mites, which are hardly visible with the naked eye, emerge from the scales of the leaf-buds early in spring, and attack the tissues of the unfolding leaves. The blisters soon begin to show as small red spots, each of which has a small central hole on the lower side of the leaf. The eggs are laid inside these blisters, and the young, escaping through the central opening, at once form new galls, until sometimes the greater part of most of the leaves is rendered unfit to perform its functions.

"When mature the galls are brown and spongy in texture, and are raised perceptibly above the surface of the leaf. Before the leaves fall the mites leave the galls, and secrete themselves beneath the scales of the winter buds, where they remain throughout the winter.

"As a remedy, kerosine emulsion seems to be the only substance which, up to the present time, has given any promising results."—From "Report of the Ontario Fruit Grower's Association," p. 113, published in the 'Annual Report of the Department of Agriculture of Ontario for 1892.'

For those who do not care to be at the trouble of mixing the emulsion themselves, the very similar mixture sold in this country, under the name of "antipest," and especially referred to in the preceding paper on Gooseberry Red Spider, p. 37, would be found to have very nearly (or precisely) the same effects.

* Nalepa, 'Zur system der Gallmilben,' Sitzgsbers, 1890, pp. [50, 51] 11, 12; plate iv., figs. 1, 2. See also references in 'Katalog. der bisher beschriebenen Gallmilben,' by Dr. Nalepa, pp. 275 and 296.

Something, however, towards checking resettlement of the infestation might be done by syringing the leafage when the Gall-mites are wandering about. During last summer, Mr. W. Gibbon, of Seaford Grange, near Pershore, in a few remarks which he sent me on this Pear-leaf attack, mentioned that under microscopic investigation he found that these Mites were very similar in appearance to those of the Black Currant, "but more active."

Dr. E. L. Taschenberg says of them that the "sexually developed Mites move about fairly nimbly on the under side of the leaves. They are found throughout the whole year, from May onwards, of various ages, and have many broods, so that multiplication continues uninterruptedly until the winterly season. They disperse themselves, both as larvæ and developed Mites, in the leaf and flower-buds of the one-year old twigs, embedded in the felt-like layer of hairs on the inside of the outer bud-scales."* Dr. Taschenberg draws attention to the infestation having been found to begin its yearly course on the lower leaves of the twigs, whilst the upper are still free, and therefore points out that if these infested leaves are cleared it will greatly help to check attack, especially in nursery grounds.

In my own observations I have thought that syringing with soft-soap compounds on the leafage in summer was useful; and (in my own observations) I have thought I found all the colours of Mite-gall which are mentioned separately by different writers; sometimes bright rose-colour, sometimes green, as well as brown in the advanced stage. The following notes on the *Phytoptus similis* are abridged from the full description, by Dr. Nalepa, on page 89:—

PLUM-LEAF FUNNEL-SHAPED GALLS.—*Phytoptus similis*, Nalepa. "Body cylindrical; female five times as long as broad. Thoracic shield three-cornered, with somewhat angularly curved out margin." . . . "The proboscis is short (0.015 mm.), strong, and directed downwards and forwards. The legs are strong and distinctly jointed; the last joint is inconsiderable, shorter than the preceding. The bristles are very fine and moderately long. The claw is short; the holding-claw ('Haftklau') is very slender, feather-like and five-branched. The abdomen is uniformly ringed (about 60 rings), and rather coarsely punctate. The egg round, 0.036 mm."

P. similis produces the galls on the leaves of *Prunus domestica*, L., shown at Plate VI., fig. 6. They are known under the names of *Cephaloneon hypocrateriforme* and *confluens*, Bremi, and are pouch- or funnel-shaped. They are mostly found on the edge of the leaves, but rarely on the leaf-stalk, or at all on the twigs or fruit? They are always few, with stiff hairs, and form one with another a surrounding

* 'Praktische Insecten Kunde,' by Dr. E. L. Taschenberg, Part V., pp. 159, 160.

boundary fence, commonly to the upper side of the leaf, less frequently to the under side. ? *Volvulifex Pruni*, Am.*

On the 7th of June, some Damson leaves, infested to an unusual amount round the edges by the above-named little lumpy galls, were sent me by Mr. C. D. Wise from Toddington. They also infest the leaves of the Sloe (*Prunus spinosa*, L.), but I have never found them myself in large numbers, nor had them reported as the cause of serious mischief. †

* (*Loc. cit.*, p. 87) pp. [53, 54] 14, 15, Plate VI., Figs. 2, 3. Also see reference in 'Katalog' there cited, p. 299.

† The following technical description of *P. similis* is given as a single example of the clear and thorough method of description of very many *Phytoptal* infestations in the successive publications of Dr. Nalepa.—E. A. O.

Phytoptus similis, Nalepa.—"Körper walzenförmig, ♀ funfmal so lang als breit. Thoracal-schild dreieckig, nach hinten scharf abgesetzt, mit etwas winkelig ausgebogenen Seiterrändern. Die Zeichnung des Schildes ist sehr deutlich und besteht aus einer Anzahl unregelmässig wellig verlaufender Linien, zwischen welchen in den Seitentheilen noch strichförmige Hocker sichtbar sind. Die Hocker der Rückenborsten stehen vom Hinterrande ziemlich entfernt und tragen die steifen, kurzen, nach aufwärts gerichteten Rückenborsten.

"Der Rüssel ist kurz (0.015 mm.), kräftig und nach abwärts und vorne gerichtet.

"Die Beine sind stark und deutlich gegliedert, das Endglied ist unbedeutend kürzer als das vorhergehende. Die Borsten sind sehr fein und ziemlich lang. Die Krallen sind stumpf, die Haftklauen sehr zart, federförmig, funfstrahlig. Sternalleiste ziemlich lang, Epimeren ziemlich kurz. Zweites Brustborstenpaar über den Epimerenwinkel und der Sternalleiste sehr genähert.

"Das Abdomen ist gleichmässig geringelt (circa 60 Ringe) und ziemlich grob punctirt. Der Schwanzklappen ist deutlich und schmal, die Analborsten sehr lang und wie die Abdominalborsten ungemein zart. Nebenborsten fehlen. Erstes Bauchborstenpaar sehr lang und fein, zweites Paar sehr kurz, kaum sichtbar.

"Die äussere weibliche Geschlechtsapparatur sitzt unmittelbar unter den Epimeren. Die untere Klappe ist halbkugelig, beckenförmig, die obere gewölbt und glatt. Genitalborsten noch seitenständig.

"Eier rund, 0.036 mm.

"Länge des Weibchens circa 0.23 mm., Breite circa 0.045 mm., Breite der ♀ Geschlechtsöffnung 0.026 mm.

"Länge des Männchens circa 0.15 mm., Breite 0.04 mm. *Phytoptus similis* hat eine auffallende Ähnlichkeit mit *Ph. goniothora* aus den Blattrandrollungen von *Crataegus oxyacantha*, L., doch unterscheidet er sich leicht von diesem durch die bedeutendere Grösse, die Zeichnung des Schildes, die Haftklauen und das schmalere geringelte Abdomen.

"*Ph. similis* erzeugt die Taf. VI., Fig. 6, abgebildeten Gallen auf den Blättern von *Prunus domestica*, L. Sie sind unter dem Namen *Cephaloneon hypocrateriforme* und *confluens* Bremi bekannt und sind taschen-oder trichterförmig. Man trifft sie meist am Rande des Blattes, nur selten am Blattstiel oder gar an den Zweigen oder Früchten (?). Sie sind immer sparsam, steif behaart und besitzen einen von einem ringförmigen Wall umgebenen Ausgang in der Regel an der Blattoberfläche, seltener auf der Unterseite. ? *Volvulifex Pruni*, Am."

'Zur Systematik der Gall-Milben, in Sitzungsber d Kais Akad. d. Wiss. in Wein,' 1890. Separate impression, pp. 14, 15 [53, 54].

BLACK CURRANT-BUD GALL, *Phytoptus ribis*, Westwood and Nalepa.— This is the species which is the most hurtful to us of any of the *Phytopti*, and we know it generally as a cylindrical Gall Mite, with the abdomen uniformly ringed, with four legs, and multiplying by eggs, and otherwise coming under the description of the genus *Phytoptus*, of the sub-family *Phytoptina*, one of the two great divisions of the family of the *Phytoptidæ*.

The description of this Gall Mite, and the plate in which it is figured, are in course of preparation by Dr. Nalepa.

The galls we know only too well, as buds swelled into round or irregularly shaped growths, sometimes hardly advancing beyond mere small balls of deformed embryo growth, sometimes advancing so far as a slight development of the leaves, or possibly of the flower-buds. Accompanying this gall formation, both within its scales, and more generally dispersed, there are very commonly to be found minute gold coloured round bodies or drops, which would not be worth alluding to excepting for these having been recently brought forward and figured (in this country) as a form of gall caused by the same Gall Mite that forms the distorted bud gall. *This I believe to be wholly inaccurate.* From the time of my first observation of this Black Currant attack, I have noticed these yellow globules, and never found them to be other than little globules of moisture, neither have I been able on enquiry to find that they had been, on the investigation of other observers, to be anything but little round gold coloured fluid drops.

One of the earliest of the communications sent me last season was forwarded, with specimens accompanying, on the 7th of April, from Bekesbourne, near Canterbury, by Mr. W. Gardner. In this instance, the fourteen twigs, or lengths of twigs, of Black Currant were severely beset with the roundish swollen gall growths, caused by the *Phytoptus ribis*. On one of the shoots which was slightly branched into six short side-twigs, I counted as many as twenty galls in a length altogether of less than twenty inches. The galls were of different sizes, but in a large proportion they were of three-fifths, or more than three-fifths, of an inch in diameter. The *Phytopti*, or Gall Mites, within were of various stages of growth.

This attack proved very destructive to the hopes of a fruit crop. On the 2nd of October, Mr. Gardner again sent me specimens (in this instance a large packet), showing what might be certainly described as an overwhelming amount of infested and malformed buds, and the shoots on which these were placed were themselves so stunted and distorted in growth by effects of previous infestation, as to some degree to resemble the condition of Birch twigs, before the *Phytoptus* growth, known as "Birch-knots," has developed beyond its first stages.

Mr. Gardner remarked :—" I think I told you that I only gathered

half a bushel off nearly five acres. You will see the dead branches that should have borne fruit dried up. When I first discovered it (or soon after), I heard that people were washing; . . . but I could not see, nor can I now see, how washing them could do any good, they seem so completely in the bud, indeed many of the bushes look like dying. I saw a neighbour some time since who said they had had them more or less for five or six years, particularly on the 'Baldwins.' "

The following notes refer to the effect of cutting-back infested bushes as a means of checking the attack, and also to removal of the infested buds and destroying them as a measure of preventing increase, if not of getting rid of the infestation.

On the 29th of September, Mr. John Speir, of Newton Farm, Newton, near Glasgow, was good enough to favour me with the following observations:—"In further reference to yours of 26th ult., *re* Black Currant Mite (*Phytoptus ribis*), I have pleasure in saying that from an examination of the bushes to-day, I am inclined to believe that the treatment adopted has been entirely successful. I had only two affected bushes to experiment on, and of course owing to the small number experimented with, it would be rash to be over confident until other more extended trials are made.

"The details are as follows:—The two bushes (about ten years old), and both with single stems, were affected all over, and during the autumn of 1891 they were cut down to within two or three inches of the ground, the branches being carefully gathered together and burned. A mixture of soft-soap, half a pound, dissolved in one gallon of hot water, to which two gallons of paraffin oil had been added, and well stirred, and afterwards mixed with an equal quantity of cold water, was syringed on to the stumps of the old bushes, the bushes round the affected ones, and all the ground round about.

"One of the bushes came away healthy and strong the following spring, but the other looked very delicate for a considerable time; ultimately, however, it seemed as healthy as the other. During the spring of 1893, no affected buds were noticed, neither on the bushes which were cut back, nor on the others surrounding them, and this year, although very much deprived of light and air by the higher bushes around them, both seem in a very favourable way of making good growth and healthy wood in the future.

"I am inclined to believe that these bushes were cut back a little too far, but I had had so many failures in attempting to eradicate this pest in the past, that I wanted to be as sure this time as possible, well knowing that if the treatment was successful other attempts could be made later on with longer stems. If the stems were a few inches longer, more stronger growth would come away, and the plant would sooner be a bush again. As my stock of affected plants is now all

used up, I cannot make another experiment until I get hold of one or more diseased plants, but I think the treatment might be equally successful by cutting off the branches, say, six inches above the ground.

“Two parts of paraffin easily combine with one part of water when soft-soap has been dissolved in it, the combination forming a white thick fluid like butter-milk. This forms the stock, and may be diluted to any extent, according to the purpose for which it is used. These few particulars I hope will serve your purpose.”

On the 5th of October, Mr. Speir wrote me further regarding the benefit, but still only partial benefit, which he had found to result from removing the infested buds:—“Prior to 1890, I had several bushes affected with the Gall Mite, and could experiment freely with them without running the risk of killing off my stock of diseased bushes, and for several years previous to that, I went over each of several bushes once every week with the most extreme care, and plucked out every affected bud as it showed itself during the spring and early summer months. These buds I carefully kept, and at once carried them to the fire, where they were destroyed. In this way I succeeded in preventing the disease from increasing, or from very much disfiguring the bushes, but on no plant did I succeed in eradicating the mischief. The most I succeeded in doing, was to prevent the disease from becoming worse, and that was at an expenditure of time and patience altogether out of proportion to the value of the crop. It therefore seems probable to me that in spring you will find your efforts in a similar direction have not met with a due reward. It will, however, be interesting to note how your experience compares with mine.”—(J. S.)

In the course of the summer I had had the advantage of examination of my Black Currant bushes together with Mr. Speir, and though nothing I can do in any way can rank with the vast scale of observation carried on either at Toddington or Newton, it seems to me that for moderate garden growing, where a great extent of land has *not* to be dealt with, that disbudding and destroying the buds is one of the best *preventives* that we know of as yet. For on a moderate or small scale every bush may be thoroughly gone over, and every bud removed without great cost, and we get rid of much infestation which would have presently spread.

In reply to some remarks on this treatment which I wrote to Mr. C. D. Wise, Superintendent of the Toddington Fruit Ground, Winchcomb, Gloucestershire, he remarked:—“I am inclined to think that this is a more sure remedy than spraying with any mixture; at all events we have found the pests greatly decreased by adopting this remedy.”—(C. D. W.)

The treatment of destroying the galled buds taken in connection with syringing of Paris-green on the bushes, and dressing with caustic lime below them, has been found so serviceable on two years' experience of its effects by Mr. John Biggs, of Laxton, Howden, East Yorkshire, that I repeat his note of experiment of 1892, together with his observation contributed this year (1893) of the continued success.

Mr. Biggs observed, writing on the 20th of April (1892):—"You will, I am sure, be interested in knowing that I have, to a certain extent, prevented the *Phytoptus* utterly ruining my Black Currant trees. As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I procured from Messrs. Blundell,* and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring I had a boy gathering all the little knobs off the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop. Our neighbour's trees, in this village, are utterly ruined, scarcely a leaf to be seen this year, and the trees completely covered with the affected knobs."—(J. B.)

On the 7th of March of the past season (1893), Mr. Biggs wrote as follows:—"I may say with reference to the *Phytoptus*, that I have very few infested Currant trees this spring, and I am confident the treatment of Paris-green and caustic lime is a valuable remedy. As soon as the buds open out slightly, I intend syringing the trees, and hope to completely eradicate the pest without injuring the trees otherwise than by cutting off some of the worst infested branches."—(J. B.)

This treatment, it will be seen, comprehends method of cure, or prevention for the Mite presence, in all the three localities in which we have to do with them. There is the mechanical measure of breaking off the infested buds and destroying them, by which we get rid quite safely and surely of all the Mites and eggs on which we can lay our hand. Then secondly, the syringing with Paris-green poisons the surfaces of the stems, or other parts of the bush on which the Mites are wandering free, so that those which are straying about are killed; and thirdly, the good dressing under the bushes with caustic lime gets rid of such of the pests as are harbouring about fallen leaves, or in any shelter on the surface of the ground. On the face of the thing the plan seems to meet the various needs of the case. The applications might be varied experimentally, where there was objection to use of Paris-green, by trying good washings with soft-soap and paraffin, or soft-soap and sulphur, or a mixture of some gas-lime with the caustic lime.

* Address of the firm is, Messrs. Blundell & Spence, Hull,

In the earlier part of this paper, I have particularly drawn attention to the subject of the facilities now given for scientific identification of the Gall Mites, or Phytoptidæ, as I believe that this meets a great need for all who have to teach or who are consulted on the nature of these "Mites," or the injuries they cause. For common use in garden or field work, the nature of the diseased growth must necessarily be the distinguishing mark of the kind of attack; but we have greatly needed some work of reference from which those who wished to know all concerning these Mites (as classification of sub-families and distinctions of genera, and also complete details regarding distinctions of species so far as at present published, in addition to life-history of the family) could tell, or be told, all that can be needed.

There are many works embodying much useful information on the Mites, and on the results and means of prevention of some of the infestations, and amongst those easily accessible to all here, and very serviceable, both in its short descriptions of gall, or diseased growth, caused by Phytoptidæ, and also in its masterly sketch of the rise and progress of Phytoptal discovery and observation up to date of publication, about seventeen years ago, is the paper compiled by Andrew Murray, F.L.S., given at pp. 331—374 of the octavo volume entitled 'Aptera' (Chapman & Hall, Piccadilly, London). In this, at p. 346, will be found a magnified figure of a *Phytoptus*, and still more greatly magnified figure of the anterior extremity, with its two pairs of legs, and "feather-bristle" claw. These, after figures by Dr. Franz Löw, the well-known observer of many Mite-galls and their Mite originators. These so far as they go would be a great assistance to many who have not the opportunity of studying the elaborate publications of technical observers; and so far as representation of the legs as definitely jointed into *coxa*, *femur*, *tibia*, and two-jointed *tarsus*, bearing a feathered claw, are valuable aids to students. With regard to the side claw, it appears to me very likely that that would now be differently represented with the improved microscopic powers of the present day, but the feather-claw is an important point.

Those who wish to study the most recent publications on Phytoptal observation in Austria, Italy, or France, will find a list of these in the 'Katalog der bisher beschriebenen Gall-Milben ihrer Gallen und Nahrungspflanzen, nebst Angabe der einschlägigen Literatur und kritischen Zusätzen. Zusammengestellt von Prof. Dr. Alfred Nalepa, in Linz-u-Donau. Abdruck aus der Zoologischen Jahrbüchern (Gustav Fischer, in Jena).

The publications by Dr. Nalepa, from which I have quoted in the preceding paper, are the 'Beiträge z. Syst. d. Phyt., Sitzsb.,' 1889, 98. = 'Beiträge zur Systematik der Phytopten, in: Sitzungsber. d. Kais. Akad. d. Wiss. in Wien,' 1889. Bd. 98, 1, 1889; also, 'Zur Syst. d.

Phyt., Sitzgsb.,' 1890, 99. = 'Zur Systematik der Phytopten, in: Sitzungsber. d. Kais. Akad. d. Wiss. in Wien,' 1890. Bd. 99, 1.

The first mentioned in the two above paragraphs are separate impressions from the Reports of the Imperial Nat. Hist. Society of Vienna, to which the reference follows each title, and I give both references, as the cost of the pamphlets, 3/6, or thereabouts, is very considerably less than that of the volumes of the Reports or Transactions of the Imperial Society.

For those who might perhaps be in doubt as to how to procure them, I may mention that Messrs. W. Wesley & Son, Essex Street, Strand, London, W.C., have made arrangements to procure them on application.

STRAWBERRY.

Daddy Longlegs; Crane Fly. *Tipula oleracea*, Linn.; and other species.



TIPULA OLERACEA.—Daddy Longlegs: 1, larva; 2, pupa-case standing up in the ground; 3, fly; 4, eggs.

Amongst the communications sent in during the past season regarding the very well-known field pests, the grubs of the Daddy Longlegs, there were two which may perhaps be worth noting, as referring respectively to presence of the grubs in a garden crop not often reported as infested by them; and in the other to effect of rape-cake (? mixed

with Mustard) in poisoning the grubs, which point may be worth further experimental enquiry.

About the Strawberry bed infestation. On the 1st of June, an enquiry was sent me from Newmains, Scone, Perth, N.B., by Mr. J. G. Bryden, accompanied by specimens of Daddy Longlegs grubs, nearly or quite full-grown, and as nice healthy specimens as one could have wished to see if beneficial insects.

Mr. Bryden noted:—"I enclose specimens of grub, or caterpillar, found among my recently planted Strawberry runners. They are found about the roots of the plants, and seem to commence their work of destruction by severing the leaf-stems from the roots immediately below the ground, thus killing off large numbers of otherwise healthy plants.

"The land is of very moderate quality, and variable, from stiff loam to fine free soil; the grub, or caterpillar, is over all alike; it was manured with ordinary farmyard manure, with four cwt. bone meal additional.

"What treatment do you think would be successful in eradicating the pest, and save my plants? I will be planting again next spring, and should much like to know if by any application I could save my Strawberries from such an attack in future."—(J. G. B.)

It will be noted in the above communication that the Strawberry ground was manured (besides the bone meal) "with ordinary farmyard manure." It is very likely that the grubs might be conveyed in this to the Strawberry beds. This kind of grub is to be found at times in farm manure; and in 1883, one of the years in which damage by these *Tipula* larvæ was being especially reported, I had a good note from Mr. David Byrd, Tarporley, Cheshire, a very careful observer, mentioning, with regard to some Turnips, that "the Daddy Longlegs grub was there in numbers, carried into the field with the foldyard manure, and spread in the ridges."

In the previous year (1882), I received information from Felhamp-ton Court, Church-Stretton, of "great injury being caused to a bed of Strawberries by means of a grub," which turned out to be of one of the smaller kinds of *Tipula*, apparently the *T. maculosa*, or "Spotted Crane Fly," which appears to be just as injurious as the *T. oleracea*, more especially observed as the Daddy Longlegs. In this instance "the plants had been top-dressed in the autumn with nearly rotten horse manure, and at the time of writing were coming through nicely, but about twenty per cent. failed, going off after they first started. The grub was to be found with its head well into the heart of the young plant, and the leaves all bitten through at the bud."*

* 'Report of Observations of Injurious Insects for 1882,' by E. A. Ormerod, p. 16.

To get rid of the attack, scooping away the earth round each plant was tried, and proved perfectly successful. About half the plants were found to be infested, often with four or five grubs round one plant, but some (nearly or quite destroyed) with only one. The single clearance was quite effectual, not another plant being lost afterwards.

Where the Strawberry grounds are on too large a scale for the above treatment to be considered applicable, it would be well worth while to try the effect of trapping. The grubs will sometimes collect in great numbers under sods. In 1883, in some information placed in my hands by the Hon. Cecil Parker, writing from the Eaton Estate Office, Eccleston, Ches., he mentioned: "*Dozens of grubs are found under a sod*"; and later on, from another correspondent, I had a note of no less than ninety-four grubs having been counted beneath a single sod "which had been brought to the surface by the harrow, and then pressed down by the roller, so as still to retain a little moisture." Following up these observations, I have suggested placing damp turfs at infested spots, and clearing them from time to time, and the plan has been found to some extent successful.

In a limited space such as Strawberry beds in garden growing, the plan might very likely be serviceable; or clods, bits of slate, or flat stones, which would afford a cool, damp, and dark shelter for the grubs, would very likely also answer, at least they would be worth trying, as with this crop, at the time of year when the grubs are most mischievous, it is nearly impossible, or quite impossible in some cases, to bring the regular remedies to bear which are commonly tried in field service.

A further point, however, might be tried as to effect of rape-cake for drawing away the grubs. They have been known to remain in it long enough in field treatment for the roller to be taken over them, and thus many may be killed, and in garden culture the beds might be hand-picked; but, beyond this, a note I received last season points to possibility of killing them by the application of rape-cake.

On the 5th of August, Mr. R. Scot Skirving, writing from Foreland House, Island of Islay, N.B., regarding methods of destroying the grubs of the *Tipula oleracea*, of which he observed: "I have had only too much experience," remarked that the measures I suggested were good, but that he had found that *crushed rape-cake* sown over the surface of the field answered much better. "The grubs were seen in hundreds dead on the surface." . . . "I then followed it up by lightly dressing the field with nitrate of soda to stimulate the growth of the plants."—(R. S. S.)

On making further enquiry of Mr. Scot Skirving, he told me that he could not now give me precise details as to the kind of rape-cake used, but that at the time he wrote of, the use of the cake was general

in East Lothian. It was the *common rape-cake* that was used for the cattle.

“It *tasted* of Mustard seed. Cattle did not like it at first, and had to be coaxed by mixing it with linseed-cake. It was used because it was *cheap*.”

On turning to Youatt's ‘Complete Grazier’ (13th Edition, 1893, rewritten and enlarged by Dr. Fream), at p. 206, I find the following statement, which confirms Mr. Scot Skirving's views as to the nature of the rape-cake, and may bear serviceably on the subject of its possible effects:—“*Rape-cake* is less relished by cattle than linseed-cake, and they require to be coaxed into partaking of it; once habituated to it, they consume it freely. Dr. Voelker says he believes ‘the pungent principle in rape-cake arises from the presence of Mustard seed, which is often contained in considerable quantities in foreign rape-cake.’ Mustard and Rape seed belong to the same family of plants; and in Germany at least, I am sorry to say, our Rape fields are often very foul with Mustard.”

The above quotation explains the taste of Mustard being present in the cheap cake alluded to by Mr. Scot Skirving, and if in the coming season any correspondent should be disposed to kindly let me have a supply of a few dozen Daddy Longlegs grubs,* I should be glad of the opportunity of making some experiments, such as I tried in 1882,† with regard to effect of rape-cake, and also of Indian, or Kurrachee rape-cake, that is, cake formed of Mustard seed, on Wireworms.

These were undertaken to ascertain whether there was any foundation for the popular idea that Wireworms feed on rape-cake to such a state of repletion that they burst. Such, however, did not prove to be the case. The Wireworms that were fed solely on true rape-cake for several weeks (broken up and moistened) went into it at once, and continued to thrive until there appeared no reason to continue observation any longer.

Those fed on the Kurrachee, or Mustard-cake, on the contrary, refused to enter the cake for about three days, and remained in a bit of turf which I had placed as a temporary and optional shelter for them. About the fourth day, when a putrescent smell had succeeded the first stinging scent of the moistened Mustard-cake, the Wireworm went into it, and did apparently well for more than a week; but at the end of a fortnight I found many dead or dying, and though I supplied them with fresh turf, also pieces of Potato and Turnip, as well as the cake, they all died.

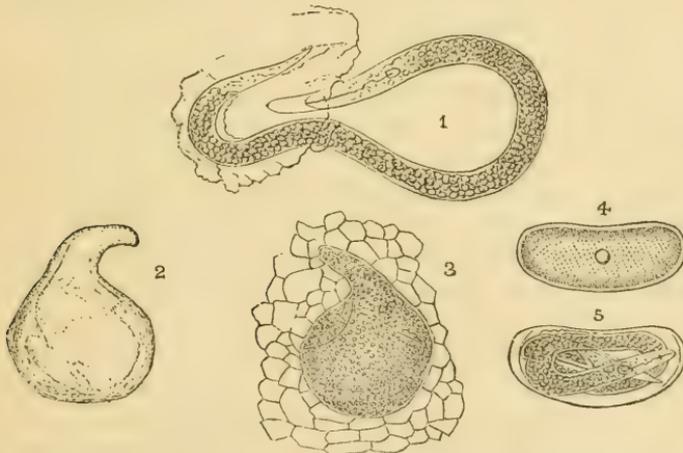
* If a letter or card was sent beforehand, this would enable me to have all ready.

† See ‘Report on Injurious Insects for 1882,’ p. 47.

Looking at the apparently much greater susceptibility of Daddy Longlegs grubs, that is, of the larvæ of the *Tipula* flies, than those of the larvæ of the *Elatér* beetles, commonly known as Wireworms, to the action of food, it would be well worth while to experiment a little on the above subject, as in case such broadscale application of Mustard-cake as is practicable in field service turned out customarily to be prejudicial to the *Tipula* grubs, it would be an exceedingly convenient addition to our knowledge.

TOMATO.

Also CUCUMBER PLANTS, &c., infested by the **Root-knot Eelworm.**
Anguillula radicola; *Heterodera radicola*, Greef.; *Heterodera radicola*, Müller.



HETERODERA RADICOLA.—1, larva; 2 and 3, females; 4 and 5, eggs in different stages of development: all enormously magnified. (2 from sketch by Ed.; the other figures after Prof. Geo. Atkinson).

In my Report for 1892, at pages 127.—137, notes are given of the observation of what I believe to be the first definitely recorded, and specifically identified, appearance in this country of the destructive Eelworm infestation, known by reason of the galls, or knots, to which it gives rise on the roots of many different kinds of plants, as the Root-knot Eelworm, and scientifically as the *Heterodera radicola*.

Full details (or at least sufficiently full details for identification of the attack) were then given, partly from the English specimens placed

in my hands, but also from the scientific details and correspondence on the subject, with which I was favoured by Dr. J. Ritzema Bos, Professor at the Royal Agricultural College, Wageningen, Netherlands, and also from the published information given by Dr. Neal, now Director of the Agricultural Experiment Station, Oklahoma, Ind. Territory, U.S.A., and more especially (duly acknowledged, as in the other cases) from the minute and carefully recorded observations of Prof. Geo. F. Atkinson, Professor of Biology at the Agricultural Experiment Station, Auburn, Alabama, U.S.A.*; but a few lines of the latter are repeated now to save trouble in reference, regarding some of the main characteristics, and especially those by which this "Root-knot" Eelworm is clearly distinguishable from the "Stem Eelworm," the *Tylenchus devastatrix*, known as causing Tulip-root, or Segging, in Oat plants, and Stem-sickness in Clover.

The eggs of the Root-knot Eelworm (see magnified figures, p. 99) are stated to be, when mature, about three- to four-thousandth of an inch in length, and the young wormlet, or larva, when it comes out of the egg, to be from twelve- to sixteen-thousandth part of an inch in length, and, like the adult male, it is thread-like in shape, and also, like it, has at the anterior extremity, in the opening of the gullet, a fine point on a trilobed base, known as the "exsertile spear."

The life-history is, that the young wormlets wander about for a time, then presently come to rest in the plant tissues, and undergo a change. The body of the larva, or wormlet, is stated to enlarge, excepting at the two ends, and forms a kind of "cyst," or chamber, in which the change of the Eelworm to the adult state takes place. If this is to the male condition, the wormlet in its chamber is stated to lengthen and become more slender and thread-like, until it is curled round several times within the chamber formed of its old larval skin; and when the change is complete, it breaks forth, roams in search of its very differently shaped mate, pairs, and dies. Its measure when full-grown is stated to be about one millimetre (the twenty-fifth of an inch) in length, and only the seventeen-thousandth of an inch at the middle, tapering to about half this width at the extremity at the head end, in which the œsophagus, or gullet, is placed, which is furnished at the foremost end with a minute needle-like point, which can be thrust out and retracted, and rests on a trilobed base. It will thus be observed that these *male* Root-knot Eelworms, from the time they quit the egg up to the perfectly developed condition, preserve the same thread-like, or fine eel-like, shape.

* 'A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radicola* (Greef.), Mull., and the Injuries caused by it upon the roots of various plants,' by Geo. F. Atkinson. Science Contributions from the Agricultural Experiment Station, Alabama, U.S.A., Dec., 1889.

With the females, however, this is quite different (still continuing to abridge from Prof. Atkinson's observations, it is noted); "the female does not moult again, but continues to enlarge enormously until it is gourd-shaped," see figures of this gourd- or pear-shape, p. 99; this female gradually becomes filled with eggs and young larvæ; and the length of the life cycle is given by Prof. Atkinson as one month.

In the very large amount of specimens of galled Tomato roots sent me in the winter of 1892-93, I had good opportunity of observing these peculiarly shaped Eelworms, and their contents, so far as could be done with moderate microscopic powers, and their description, and that of the galls on the roots, is given in my Report; and later on, towards the end of March, I was able also to examine the nature of the root-knot galls, and the condition of the Eelworm tenants in galled Cucumber roots, sent me by Mr. Hamilton H. Hurnard, from Gurney's Manor, Hingham, Attleborough, Norfolk.

Mr. Hurnard first wrote as follows:—"Last year I was very much perplexed at the condition of my Cucumber roots; no plant died, but they were not a success. This year I have lost plant after plant." On March 23rd, Mr. Hurnard forwarded me, for examination, two roots of Cucumbers taken from a large pot at seven o'clock that same morning, with the very just remark: "It is really heartrending to go into my Cucumber house and see a plant or two dead every morning, with Cucumbers of all ages on it."

On examining the specimens sent, I found the galls on the roots were very similar, both in position and appearance, to those described, on Tomato roots, in my 16th Report, p. 131, and figured on the accompanying plate about two-thirds natural size; but the Eelworms within them appeared to be not so far advanced as those in my winter specimens.

In these Cucumber galls there were many of the thread-like forms of this Root-knot Eelworm, of different sizes, some exceedingly minute; but I did not observe more than one instance of what might be a developed female. In this case the pear- or gourd-shape was observable, but the wormlet was rounded out at the base, that is, more of a tulip-bulb shape, without the central depression being noticeable. There were also one or two going through pupal changes.

With regard to specimens of this Cucumber root infestation, which I submitted to Dr. J. Ritzema Bos, Wageningen, Netherlands, for his skilled examination, he was good enough to report to me on March 27th as follows:—"In the galls I find different Nematoid worms; *Heterodera radiculicola*, in different stadia of development, and some other Nematodes, which live in the decayed matter of the galls (*Diplogaster* and *Rhabditis* species). Of the *Heterodera radiculicola*, I found one completely developed female, some males, and different stadia of the larvæ, like

those in Plate IV., Figs. 9, 17, 18, 21, of Atkinson's 'Report,' and ova."—(J. R. B.)

The Cucumber infestation which we have here, was thus found to correspond both in the kind of Eelworms, and in the galls to which they gave rise, to that of the *H. radicola*, and its effects, already studied on Tomato roots; and it was of some interest to contrast the condition of the Eelworms, in the one case (in the spring) being to a great extent growing up to maturity; and in the other, in the old matured galls towards the close of the year being so much more observably represented by adult specimens, especially the gourd-shaped females with their larval or egg contents.

The galls on the various kinds of plant roots on which I have seen them, that is, on roots of Tomato, Cucumber, and on roots of one young Lettuce plant sent me for examination from Belgium, were small knobs, or irregularly shaped lumps, varying in size from an eighth of an inch or less in diameter to (in the case of the Tomato) fleshy lumps a quarter of an inch to half an inch or more in width, and much more in length; even to as much as one, two, or over three inches of irregular swollen gall growth along the root fibres where the galls were confluent.

The method of infestation may be in various ways. The Eelworms may escape into the earth through cracks in the gall, or may make their way out by use of their mouth-spear; or again, as I found in the case of the Tomato galls sent me late in the year, may be freed in myriads by the peeling off of the outer part of the coat of the "root-knot." But in whatever way the Nematode may have conveyed itself into the ground, the next step, that of its entrance into the plant to be attacked, is thus described by Prof. Atkinson,—p. 16 of pamphlet cited.* "Having escaped from its confinement," . . . "it immediately selects another part of the root, or a fresh young rootlet, for attack, and places itself in position for the siege. Bringing into play its exsertile ram, it forcibly gains entrance to the healthy tissues of the root," &c. There the parasitic action sets up the diseased swelled growths, which, as we now know in England to our sorrow and loss, carry off the plant juices to supply the growth of these vegetable tumours, and ruin the hopes of the expected crop.

A further word should be added as to the need of great care in all investigations as to the nature of the tenants of the root-knots; those who are not well accustomed to the identification of Nematodes, cannot be too strongly warned against the error of mistaking these *Heterodera radicola*, or Root-knot Eelworms, for the *Tylenchus devastatrix*, or Stem Eelworm. The exceedingly minute resemblance of the first-

* See footnote, p. 100.

mentioned in larval and male condition to the second in every state, that is, larval, male, or female, has led to repeated and grave error; and the gourd- or pear-shaped females should always be searched for carefully, though, even in the absence of these, it is entirely presumable that the formers of the "root-knot" galls will be the *H. radicola*.

PREVENTION AND REMEDIES.—These at present appear, as a certainty, and at a paying (or indeed practicable) rate of outlay, to have eluded the most careful research. Some good it is considered may be done in special growing (as where one kind of crop can be kept thoroughly in hand, in limited space, or under glass, or in pots), by use of what are called trap-plants. That is, by sowing some small crop which is an object of attraction to the Eelworms, such especially as Lettuce, sometimes known as Salad, and keeping watch on these until it is found that galls are forming on the roots, then removing them, and destroying them with the contained pests. But in this treatment the utmost care must be taken in removal of the "trap-plants," for if they are drawn from the soil, however carefully, some of the galls, and with them the Eelworm tenants, will be likely to remain behind.

Such matters of precaution as carefully destroying all infested roots, and on no account letting them be thrown to rubbish heaps; also avoiding use of soil in which infested plants have grown; and also taking care that such infested soil is not carried about on garden tools, or on boots of garden labourers, or wheels of barrows, are all measures of at least lessening spread of the infestation. Also it has been found that the "root-knot" is worse in long cultivated and fully fertilized and thoroughly pulverized areas, than in compact and virgin soils. Such of these points, however, as seemed serviceable for general use, have been alluded to, with authorities given, in my preceding Report, and those who wish to study the subject in minute detail will find excellent information, both with regard to the Eelworms, their habits, and such means of counteracting their ravages as are known, in the works mentioned below.*

The following observations refer entirely to a long and careful series of experiments tried by the observer, from whom I received the infested Tomato roots mentioned in my Sixteenth Report. From the losses sustained by him, both in Tomato and Cucumber growing on the very large scale carried on in his houses, extending over many acres,

* 'A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radicola*, &c.,' by Geo. F. Atkinson.—A Science Contribution from the Agricultural Experiment Station, Auburn, Alabama, U.S.A., December, 1889.

'The Root-knot Disease, &c.,' by J. C. Neal, Ph.D., M.D., U. S. Department of Agriculture. Washington: Government Printing Office, 1889.

he considered it would be worth while for him to try the effect of a large variety of chemical applications, carefully observing and noting effects of each, both on the Eelworms, and on the plants.

The first series of observations was conducted on Tomato plants in pots. In every case pots were used that held four and a half pounds of soil when fairly dry, and soil that was known to be infested with the "Root-knot" Eelworms. About twenty-four different kinds of chemical applications were experimented with, the precise amount applied in each case being noted and stated in "grammes."* The observations were made in almost every case with different amounts of the chemical application, these amounts, together with the effect (or absence of effect) on the plants, and on the Eelworms, being carefully noted.

Thus in these first observations before me, we have a tabulated record, as correct as the most scrupulous care can make it, of about one hundred and twenty experiments; these in most cases giving the effects of at least two, and often three, amounts of chemical application, sometimes of many more, and thus forming an interesting record of their effects on plant life; also of the instances where neither plant nor Eelworm suffered; of some where the plant was injured, but the Eelworms were still to be found; and of some where the desired end was reached, of the plant continuing in good health, but no Eelworms being observable.

The result of this first series of experiments appears to show that there are a fair proportion of chemical applications which kill the Eelworm, but the expense of the applications would in almost every instance be far too great for remunerative broadscale use. The chemical applications made use of being with a few exceptions the same combinations which were used in the later series of experiments, of which the account is appended, it is unnecessary to give the list.

The detailed tabulated notes of the foregoing experiments were placed in my hands in June, but the observer being anxious to secure absolute certainty in his results, then (with the experience gained by these first experiments) commenced a second similar series, of which, with his permission, I subjoin his own condensed report.

I cannot help regretting that I am not permitted to publish the first set, as they give precise details, observed with scrupulous care, of effects on the plant and Eelworm life which are valuable in this rarely obtainable minute detail, and if given with the preliminary note that they were tentative preliminary experiments, would have freed the

* A "gramme" is, as nearly as possible, equivalent to fifteen and a half grains English.

observer from the fear of either misleading, or of over-criticism of his long and careful work.

Such, however, being the case, I now append only the later series of observation, which were sent me in October. These were made on both Tomatoes and Cucumbers, and the effect was much the same in each case. In the various returns, the most hopeful appears to be that of carbolic acid, but of this my observer remarks:—"As I expressed to you before, although carbolic acid will be effective in a field if properly mixed, I have very strong doubts about people succeeding in greenhouses, on account of the very many crevices in which the Eelworm will be able to harbour, and if I gave out this as a cure, people would be disappointed." *

The report of my observer's later series of experiments, sent to me during October, is as follows:—"I have now completed my experiments for killing the Eelworm, *Heterodera radicum*, and, as promised, now send you an account of them. In my first experiment, I used pots that held four and a half pounds of infested soil, and to each pot I used the following chemicals, at the rate of one, two, three, and four grammes to each pot:—Magnesium sulphate, iron sulphate, tartaric acid, lead acetate, citric acid, sodium sulphite, sodium hyposulphite, sodium caustic, potassium sulphite, potassium permanganate, potassium chloride, potassium ferrocyanide, potassium sulphide, potassium sulphate, potassium caustic, potassium acetate, carbolic acid, and potassium cyanide. Gas-lime (fresh) up to twenty grammes; fresh caustic lime up to twenty grammes; tobacco powder up to eight grammes.

"The plants in the potassium ferrocyanide were all killed, even the plant to which I only used one gramme to the four and a half pounds. The plants in the gas-lime were sickly at twelve grammes; but the Eelworm was not even checked with twenty grammes. All the other plants did well, and were not injured in the least. The only things effectual in checking the Eelworm were carbolic acid and potassium

* My observer requests me, for obvious reasons of business considerations and also inconvenience in time taken up in reply to applications regarding treatment, not to insert his name and address; but for scientific communication, he has allowed me to put him in communication with Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, who aided us in identification of the Eelworms; and also with Prof. Atkinson, of the Agricultural Experiment Station, Auburn, Alabama, U.S.A.; and with Dr. J. C. Neal, Director of the Agricultural Experiment Station, Oklahoma, Ind. Territory, U.S.A., to whose published researches on the *Heterodera radicum*, or Root-knot Eelworm, all who study the subject are infinitely indebted. I am therefore not without hope that the patience and care with which the observations have been conducted over months of experiments may produce more fruit than the observer is aware of, and (at least in scientific quarters) will be credited to the right owner.—ED.

cyanide when four grammes to the four and a half pounds of soil were used. In these pots only the smallest trace of Eelworm could be found, whereas the pots in which the other chemicals were used were a mass of knotted roots.

“I then tried a second batch, using eight and twelve grammes to the pot, of all the chemicals I had tried previously, except gas-lime, caustic lime, and potassium ferrocyanide, which I abandoned; and carbolic acid and potassium cyanide, which I tried from six grammes upwards. I now found quite a number of the chemicals seemed to kill the Eelworm. Also that five per cent. of powdered charcoal seemed to kill it.

“My third batch of experiments were tried in beds of soil in which Cucumbers had been growing (and failed) through the roots being covered with the root-knots. The beds were divided into pieces containing fifteen cubic feet of soil, the weight of which would be about twelve cwt. Some of the chemicals previously used were now abandoned on account of their cost; and Paris-green and bichloride of mercury were tried for the first time. Up to one and a half cubic feet of powdered charcoal was used, and found of no use whatever; plants grew well. Up to eighty-two ounces of sulphate of iron did not affect worm or plants. Up to twenty-seven ounces of sulphate of copper did not affect either plant or worm. Up to sixty-six ounces of sulphate of potash did not affect either plant or worm. Two ounces of Paris-green made plants sickly, but five and a half ounces did not kill Eelworm. Three ounces of bichloride of mercury injured the plant, but six ounces did not kill Eelworm. Up to sixty-six ounces of sulphate of potash did not affect either plant or Eelworm; neither did sulphate of magnesia. Sixty-six ounces of sodium hyposulphite checked Eelworm only. But with thirty-three ounces of carbolic acid, hardly a trace of Eelworm could be found. The little that was found had probably come from the other soil after the effects of the carbolic acid had passed away. I cannot say that the plants were not affected by this quantity, but it was not much, and perhaps not at all. The plants might get a little check from other causes.

“You will now notice that my second and third batch of experiments do not agree with each other. Many things that appeared to kill in the second batch, quite failed in the third. I can only account for it in this way: the second batch were grown in pots on a stage in a greenhouse during June, July, and August. The sun was fearfully hot, and I had to complain to my man who had charge of the watering these plants for allowing them frequently to get very dry; and I think it probable that the continual watering and drying, with the hot sun shining on and almost baking the pots, acted injuriously on the Eelworm.

“Therefore the only thing I can recommend is carbolic acid. Potassium cyanide is much too costly; and sodium hyposulphite would be more costly if used strong enough to kill the Eelworm. And I am afraid carbolic acid, although the cheapest remedy I have found, will be far too expensive for the Americans to use. Thirty-three ounces to fifteen cubic feet is equal to 6000 lbs. to the acre, and would cost, for acid alone, about £75. Then, to be effectual, it should be thoroughly mixed with the soil with a fork: I am quite sure ploughing alone would not be sufficient. Then I think it should be used when the soil is moist, and not too cold; for the object should be to use the acid at the time when the Eelworm is most active. I do not think the strength I mention would kill eggs; and unless the eggs are quickly brought to life, the strength of the acid would pass away. I have seen Tomato plants nearly die when planted in soil directly after the acid was used and only moderately mixed, but after a week they began to recover, and soon made new roots, and grew as well as the other plants that were in soil where no acid at all was used.

“I am also very doubtful whether I shall succeed in getting rid of the Eelworm entirely myself. For, four years ago, my Cucumbers having what we called clubbed (and failed, and which I now know was caused by the Eelworm), we drenched the walls and surface of a house with carbolic acid. After, the soil the plants had been grown in was wheeled out. And we used the acid very much stronger than now seems to be necessary. And yet the Cucumbers clubbed and failed in the same way in the following year.

“In May of this year, I used carbolic acid in various strengths in a house where Cucumbers had grown. The greatest strength being nearly twice as much as the thirty-three ounces to fifteen cubic feet. But we did not plant Tomatoes in the soil until five weeks after using the acid. For a time it seemed as though most of the Eelworm was killed. But now, four months after planting, the Tomatoes are getting quite badly affected. It seems to me that in a greenhouse there are so many places in which they can harbour, that it is impossible to get at all. In a field it would be different; and I have not the slightest doubt but that a dressing of 6000 lbs. of carbolic acid to the acre, used properly, would completely clear the Eelworm.

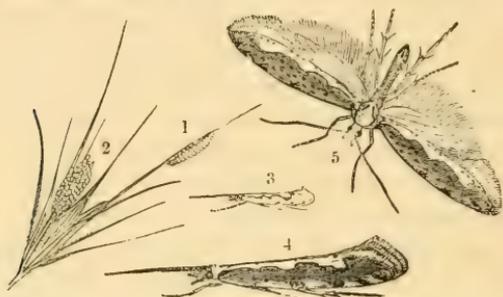
“If you care to mention anything I have written in your Report, you are quite at liberty to do so, but, please, do not mention my name in it. If you are writing to Dr. Ritzema Bos, Dr. Neal, or Professor Atkinson, you may give them my name and address; and if they wish to write me for anything, I shall be quite willing to give them any further information I can.

“I may add, in using the carbolic acid, I always mixed it with

about twenty times its bulk of water, and then used a water-pot, with a fine rose, to sprinkle the soil, thoroughly mixing the soil afterwards."

TURNIP.

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



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

During the past season of 1893, so very little mention has been made of damage caused by the caterpillars of the Diamond-back Moth, that it seems worth while to notice this non-observation in sequence with the sudden and great amount of presence in 1891, and a good deal of injury in 1892.

It will be remembered that in 1891, a vast amount of mischief was caused by the small delicate green caterpillars of this moth (figured above at 1), to the leafage of Turnips, mainly along the coastland near the eastern seaboard of the island, and more or less in every one of the eastern counties, from Dover in Kent up to Aberdeenshire in Scotland. This was first reported about the beginning of July, and enormous flocks of the moths were also observed at various places along the eastern coasts.*

In 1892, the infestation was again present, but not to such a severe extent; also it was observed earlier in the season; the reports of damage ceased also earlier. The first notices of moth presence,

* The fullest possible account of all details of this infestation, given from special reports of observations in the area of injury, will be found in my paper on "Diamond-back Moth," given in the Journal of the Royal Agricultural Society, Vol. II., Third Series, Part III., pp. 596—630; and at pp. 105—164 of my own 'Annual Report of Observations of Injurious Insects,' for 1891.

respectively in Norfolk, Yorkshire, and in the county of Fife, N.B., and some other localities, were sent me in the latter part of May. Notes of caterpillar damage of these larvæ being spun up for the chrysalis state were sent on the 20th of June, and no reports of serious mischief were forwarded me after the 11th of July, and none at all after the 29th.

During the summer of 1893, I did not receive any observations of ravage, and scarcely any of the appearance of this attack; nor was there any report given by the agricultural press of continued visitation of the pests; and on communicating with Mr. E. A. Atmore, F.E.S., of King's Lynn, Norfolk, in which district the Diamond-backs had been very observable in 1891 and 1892, he wrote me as follows:—“*Plutella cruciferarum*, Z., the Diamond-back Moth, has been conspicuous by its absence (so to speak), for I have only seen two specimens, *imagines*” (*i. e.*, in moth condition—E. A. O.), “during the whole year, and no traces of the larvæ on Turnips, &c.”—(E. A. A.)

It has seemed worth while to allude again to this infestation, which excited so much attention on its great outbreak in 1891, relatively to the possibility or great probability of it having been wind-borne from Norway, where, as we now know from the list of the ‘Norwegian Lepidoptera,’* published by the State Entomologist, Dr. W. M. Schøyen during the past year, this species, the *P. cruciferarum*, is very widely distributed.

In this revised Catalogue, bringing the list of Norwegian Lepidoptera up to present date, Dr. Schøyen has tabulated the distribution of species in parallel columns, with the names of the provinces (or main districts, as Christiansand, Tromso, Finmark, &c.) in which their presence has been recorded, and the latitude of their most southerly and northerly observation.

From this it appears that the *Plutella cruciferarum*, known by us as the “Diamond-back Moth,” has been recorded as present in all the eighteen main divisions of Norway, except Bratsberg and Bergenhús (N. and S.). Its distribution is from latitude 58° N. (that is, from the southernmost extremity of Norway), to 70° 42' N., that is, further north than Hammerfest, and only a few miles short of the extreme north of the mainland of Norway, or, one might say, to the extreme north, as the few miles left are so indented with fiords, or arms of the sea, as really to leave very little land at all.

The above notes, taken from a work of authority and careful compilation, appear to me well worth observation in connection with insect appearances coincidently with easterly or north-easterly winds.

* ‘Fortegnelse over Norges Lepidoptera,’ af W. M. Schøyen. (Christiania Videnskabs-Selskabs Forhandling for 1893, No. 13).

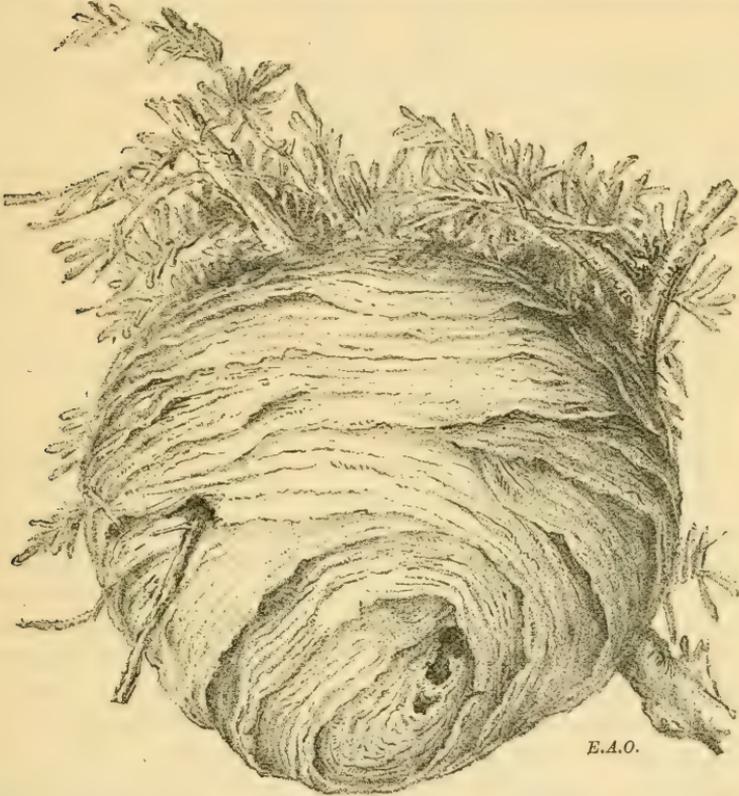
In the great appearances of Diamond-backs in 1891, we had record, in such data as were procurable, of the "cloud of moths" that arrived at the Farne Islands, being driven by the N. E. wind; and at Leith, in Scotland, the direction of the wind at 8 a.m. on the twenty of the thirty days of June (as given in the daily weather report issued by the Meteorological Office) was E., E.N.E., or N.E., points very notable in connection with the very great amount of attack which occurred in Fifeshire, a seaboard county especially exposed to the action of easterly and north-easterly winds.

At present, and in regard to this special infestation which gave so much sudden trouble in 1891, and, being established, set on foot mischief to trouble us, though ceasing earlier, and altogether not so severe in 1892; it is enough for us to be thankful that it did not recur over the infested districts (so far as appears) for a third time.

But for those who may need to trace the origin of future attacks, Dr. Schöyen's plainly arranged entomological and geographical columns may be of service; and it may be well to mention that these being given in the ordinary scientific wording there is no difficulty, excepting in the short introduction and title-page, to be overcome by those who (like myself) may find trustworthily translating what they may require from the Norse language an anxiously laborious task.

WASPS.

Common Ground-building Wasp. *Vespa vulgaris*, Linn.
Hornet. *Vespa crabro*, Linn.; and five other species.



Nest of Tree Wasp, after sketch from original specimen by Ed. Dimensions, 8 in. across by $7\frac{1}{2}$ deep.*

The most remarkable insect appearance of the past season was that popularly known as the "Wasp plague." The very unusual prevalence of Wasp presence was reported from almost every one of the many localities in England, from which replies to my enquiries were forwarded to me, and though the infestation was not so general in Scotland, it was exceedingly troublesome over some large districts, notably by the Moray Firth; in the Lothians, and in some of the islands on the west of Scotland.

* As the tenants of the nest were not identified at the time, I cannot say with certainty whether it is that of *Vespa sylvestris* or *V. norvegica*.

The enormous excess of Wasp presence above the average was in many places nothing short of a calamity, inflicting pain, and to some degree danger to ourselves, and to horses exposed to sudden attack, and great loss to fruit growers.

Within our houses, in many cases, the Wasps swarmed to such a degree, and especially at meal times, as to make their presence on the food a real trouble; the agricultural or garden labourers were severely stung where working on crops to which the Wasps had been attracted by presence of Aphides, as in Bean fields, or on fruit stocks, where budding was going forward. Also pain, risk, and delay in farm work, were caused by fierce onslaughts of Wasps from nests turned up in ploughing. Great losses were caused by the quantity of fruit entirely ruined up to almost wholesale destruction in the grounds of large fruit growers, and to this must be added losses to shop-owners dealing in such commodities as find favour in the eyes of the Wasps for their own consumption, or thievish abstraction for food of the coming on generation still in maggot condition, to be counted by hundreds, in each of the vast number of nests which were the head-quarters of the marauding and troublesome pests.

The question was frequently asked,—What was the cause of such an unusual visitation? and there appears no reason to doubt that the exceptional numbers were a consequence of the exceptionally favourable circumstances for Wasp life which was supplied by the early and long continued dry weather of the spring. Thus there were not the usually returning intervals of cold and wet to catch and destroy the queen Wasps when warmed into active life, and drawn out from their winter shelters by what, in most years, is an alternation of sunshine, with weather that leaves the houseless queens between whiles (and much to our benefit) exposed to just the conditions unfavourable to their own existence, and likewise to that of their embryo nests. Where these most fragile structures of just a cap of paper-like material, perhaps not an inch across, with a few eggs or maggots, as yet not sheltered around from inclement weather influences, are exposed to all the varieties of temperature and circumstances customary in March and April, we have a most serviceable preventive condition, which was not the case in the long settled drought of last spring, and of which we saw the consequences.

Before going on to the reports of the year, it may be of service to give as shortly as possible an account of the ordinary method of Wasp life in this country. That is, the history of the Wasp colonies from their rise, by the work of a single female in early spring, through the increase of tenants during the summer, up to many hundreds, or a few thousands, and the coincident enlargement of the paper nests, on to the decay and desertion of these nests in the autumn, when all that

remains of the great summer family are a comparatively few females, commonly known as queens, which have left the nest and stored themselves away for their winter quietude in sheltering nooks to wait the spring sunshine for active life and labour.

Species of British Wasps.—In Britain we have seven species of social Wasps, that is, of Wasps living together in societies formed of



VESPA VULGARIS.—Largest specimen, queen, or female; specimen to left-hand, with long horns, drone, or male; right-hand specimen, neuter, or worker.

males, females, and neuters, or abortive females, commonly known, respectively, as drones, queens, and workers.

The seven kinds of Wasps are divided into two sections of Ground Wasps and Tree Wasps, according to whether their nests are customarily formed in a hollow in the ground, or suspended in the air from a bough, or in a hedge, or, as with our largest species, the *Vespa crabro*, the splendid insect known as the "Hornet," the nests may be found in decayed trees, in roots, under eaves, or, as I have myself found it, down in the ground by a small post of a field paling.

The species of the Ground-building Wasps are the *Vespa vulgaris*, Linn. (see figure); the *V. germanica*, Fabr.; and the *V. rufa*, Linn., which is somewhat smaller, as regards the queens and workers, than the two preceding kinds, but variously marked, especially on the two first segments of the abdomen, with a red tinge. As I have seen it (especially on one occasion when, by mishap, I had to hold the entire colony of a disturbed nest down on the ground within my ring-net to enable my unwasp-protected colleague to escape), the difference in tint is a very fair general distinction.

Of the four species of "Tree Wasps," the most common are the *Vespa sylvestris*, Scop., and the *V. norvegica*, Fab. (the *V. britannica*, of Leach); of these the first is widely distributed, the second is not so common in England, but said to be abundant in Scotland. The *V. arborea* is so very rare that it hardly needs mention. I was, however, fortunate enough to find two specimens at Sedbury Park in the

west part of Gloucestershire whilst observing and collecting to help my late brother, Dr. Ormerod, in the formation of his volume on 'British Social Wasps,'* which, on being submitted to the late Mr. Fred. Smith, of the British Museum, were identified by him as being queens of the *V. arborea*.

The *V. crabro*, or Hornet, is easily distinguishable from the other species of Wasps by its greater size, and its large proportion of rusty or reddish colouring. In the part of Gloucestershire mentioned above,



VESPA CRABRO.—Hornet (queen).

where there was much woodland, it was not at all uncommon, but its range of habitat is given as not extending, as far as known, so far north as Yorkshire.†

In general habits it resembles the smaller Vespidae, commonly known as Wasps, but by preference appears neither to build under ground, nor where exposed to weather in trees or hedges, but to select the inside of hollow trees, or logs, or roofs of lofts or sheds; the individual colonies are less in number than those of the Wasps, and the paper of which the nests are composed is much coarser. The nests sometimes run to a great size, the largest which I have seen, and assisted in securing when deserted in the winter, was taken from a cottage roof in Gloucestershire, and measured fifteen inches across, and nineteen inches in height, although some of the lower part had been removed.‡

The main points of Wasp life during the year, and the method of formation of the paper-like nests, are given shortly in the following pages as a guide to the customary life-history. For exceptional cases, or minute structural or anatomical details, the reader is referred to the many British and Continental publications on the Vespidae.

* 'British Social Wasps,' illustrated, by Edw. Latham Ormerod, M.D., p. 42, plate 3. Longmans, Green & Co., London.

† 'Brit. Mus. Catalogue of British Aculeate Hymenoptera,' by Fred. Smith, p. 222.

‡ See 'Social Wasps,' by Dr. Ormerod, p. 211.

The Wasp colonies of the year are begun by the large females, commonly known as queens, which have survived the winter, safely stored away in the sheltered localities which they chose for themselves when the nests to which they belonged were perishing in the previous autumn. Then the females select such places for their winter rest as dark nooks in sheds, or amongst wood, or rubbish, or dead leaves, or even amongst stones, or in a dry bank; indoors (if they can manage to escape observation) they will harbour in folds of curtains, toes of slippers, anywhere in fact that is snug and quiet, until they are turned out in the latter instances, or in the former, the return of warmth and sunshine wakes them from their winter sleep or torpor.

Then comes the point at which (as before mentioned) the state of the weather affects their powers of increase to a very important degree. Wasps are very sensitive to cold and exposure, and where weather varies, as is so commonly the case in early spring, from short bright sunshine to hard frost, or sleet and snow, many of the queens who are caught by the unfavourable weather perish, and the embryo nests, with their few eggs, or lately hatched grubs, are also destroyed.

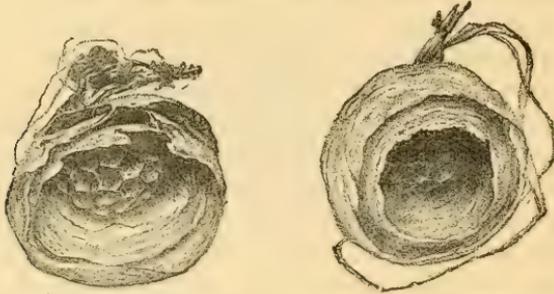
This embryo nest, when the tiny structure has advanced so far as to have any definite form, may be described as much resembling a miniature open umbrella, made of thin grey paper-like material, from half an inch to an inch in diameter of the cap, and hung by the little stout peg above it to whatever support the queen Wasp may have chosen. Continuing the comparison to a miniature umbrella to give an idea of the entire shape, the stem above the circular cap forms the suspending point, the part below (somewhat like a short club-shaped handle) is enlarged at the bottom, and here a very few cells will be found containing each an egg or young maggot. Above these is the circular thin hood, or cap, which slightly protects the young family below from weather or chills.

This embryo nest is formed of a kind of grey paper made from morsels of wood, or of bark, or material of a similar kind, worked by the Wasp into a kind of paste, or papier maché, and spread into the required form by her jaws, and it is obvious that where this minutely delicate structure of perishable material is exposed to bad weather, it is most likely to perish.

Under ground, if it has been suspended in a hole, or under a clod, where wet could reach it, the paper is likely to be ruined, and the eggs destroyed; and similarly with the bush nest-building Wasps, the little nest is likely in wet and cold weather to come to nothing, independently of the chances of the mother Wasp coming to trouble, and thus the progeny being lost. In the exceptionally dry March of 1893, in which the returns show a rainfall of approximately one-third of the average, circumstances were exceptionally favourable both to the queens and to

the safety of their families, and here it seems to me we have the reason for the correspondingly exceptionally vast numbers of these troublesome pests with which we were subsequently visited.

At first the queen has to carry on all the work of the commencing colony; to lay the eggs, feed the grubs, gather material for house-building, and use it herself for enlarging the roof of the family shelter, or for deepening the cells (which at first were little more than cups) so as to suit the needs of the growing grubs. Thus the first hood is



Wasps' nests in early stages, after photos by Dr. Ormerod.

enlarged, additional layers of paper are added, until the little nest begins to take its characteristic spherical form, and the few cells with which work began are increased in depth and numbers until they become a regular layer of paper Wasp-comb. The accompanying figures show this condition before the nest has been closed below, so as only to leave the requisite aperture for Wasp passage.

From this time, if all goes well with the colony, the work goes on regularly. The queen continues to lay eggs, and the egg condition is stated to last eight days, the larva state thirteen or fourteen, and that of the pupa about ten; thus (speaking generally) in about a month from the time of the first eggs being laid, the first Wasps of the season begin to make their appearance. These are all abortive females, known as workers, and as they keep on developing in steady succession, from the succession of eggs laid by the queen, they carry on the labours of the rapidly increasing community. Successive tiers of horizontal comb, with cells on the lower sides, have to be built to receive the eggs and accommodate the grubs, and the outside of the nest has to be enlarged correspondingly, until, in the case of the common Wasps, it may be of a somewhat spherical shape of any size from two or three to eight or more inches in diameter. The Hornets' nest, as mentioned at p. 114, may be much larger, and also very likely not entirely spherical, but built against the side of a cavity in an old tree; also the paper is of a coarser kind.

The building of the outside of the nest is carried on by the workers

stripping or rasping up small quantities of wood or vegetable material, and working these with moisture from their mouths into little pellets, which each worker carries home, as it is commonly described, in her jaws, but (from my own observation of the process) I should rather say *under them*, tucked, as it were, under her chin. Thus her jaws are free for work, and when she gets to her nest (in the case of a kind like that figured at the heading), then placing herself firmly in an inverted position, with three legs on each side of the edge of paper to be enlarged, she walks backward, spreading out her soft paper pellet with her jaws until it forms a little stripe securely joined to the former paper, but differing in colour according to the tint of the wood, or vegetable material, of which it has been made. In urgent need, as when removal of a turf had laid bare the top of a ground nest, I have known well worked up clay from some holes close at hand used to supply the much needed roof as quickly as possible.

The horizontal layers of comb within the nest are formed of the same kind of paper as the outside casing of the nest, each comb being suspended from the layer above it by short strong pillars of the Wasp-paper material, thus giving convenient room for traffic of the workers on the flat top of each comb whilst attending to the needs of the young family in the cells of the comb immediately above them. All the labours (excepting egg-laying), whether building, or repairing, fetching materials and food, clearing out rubbish, &c., have to be carried out by the workers, and in the case of ground-builders, the mere enlargement of the cavity to give room for the necessary enlargements of the family establishment is no small labour, and for those who can watch quietly it is a very pretty sight to observe the workers coming up from below laden, each one, with the little morsel of earth or pebble which was required to be excavated.

Towards autumn, the economy of the nest changes, males and females are produced, and shortly after the Wasp colony, as a social establishment, comes to an end. The drones, or males, having fulfilled their allotted work by pairing with the females, die, so also do the workers; the nest decays, and all that remains of the summer colonies and their quarters (excepting where nests may have been built in some dry locality where they are as safe as in a cabinet) are the females, which will leave the nest, and, hybernating in their selected shelters until spring comes round again, thus complete the year's circle of Wasp life.

Two points in the Wasp economy most important to us are their stings, and the nature of their food. It may be remarked that the females and workers are furnished with stings, but not the drones, or males, these are stingless. With regard to the food; taking it in the sense of what is carried off by the Wasps, partly for their own food,

but to a large extent prepared in the inside of the workers before restoring it for the nourishment of the grubs, almost anything sweet or nutritious, and soft enough for abstraction, may be considered as serviceable. Animal food, as meat, fish, insects, in winged or maggot state, all are acceptable for the family larder; honey is a great attraction; jam, sugar, fruit, to any amount, are also all acceptable, in fact it is difficult to say what may not be laid under contribution for carriage home to feed the grubs, in prepared or unprepared condition. But irrespective of this point of what they may select to supply what, when under observation, appear the insatiable appetites of the larvæ, the workers on their own account (apparently) are greatly attracted by, and stand in need of, moisture. Here we have a point on which we may constantly base most successful measures for trapping and destroying them by myriads, and with regard to their wholesale depositions, and the dexterity and apparent powers of memory with which they carry on their minor thieveries, notes will be found in the succeeding observations.*

These in many cases contain reports of amount of presence, extent of damage caused, measures of prevention and remedy, besides other details of interest; but as in Wasp attack these are much affected by local circumstances, I have not divided the information for classing under different headings, but given each report entire, with, in some instances, a heading noting the chief point alluded, and have appended a general summary of the results to be gathered from the notes.

I have also added two or three short observations of amount of Wasp presence at a few Continental localities, for which I am indebted to the courtesy of entomological correspondents, duly acknowledged together with their kind contributions.

* In my account of the general points of Wasp life and habits, I have written mainly from my own observations, taken some years ago, when collecting and observing to help my late brother, Dr. Edward L. Ormerod, whilst preparing his volume entitled 'Social Wasps,' regarding such points as required local attention in their own habitats; and also whilst collecting and preparing specimens of Wasps' nests for museum use at the South Kensington collection, then at Bethnal Green, under the curatorship of the late Andrew Murray, F.L.S. Under the circumstances, I was able to make a large amount of observations as to ordinary Wasp habits, and also experimentally, on such matters as applied to instincts under special emergencies (arranged for them), rebuilding of abstracted nests, memory in regaining former localities, and also with regard to food. These, however, are unnecessary to be entered on here, but amongst the great number of publications on Wasp life, I may mention as a trustworthy work for consultation as to the number and distinction of our British species, the 'Brit. Museum Catalogue of British Aculeate Hymenoptera,' by the late Fred. Smith. Also that in Dr. Ormerod's work on 'Social Wasps,' a great amount of information is given from his personal researches regarding their external structure, and the internal development, both in larval and imago condition.—ED.

Observations of contributors, arranged under headings of localities.

SCOTLAND.

I have preceded the other observations by the following communication with which I was favoured by my valued contributor for many years, Mr. Malcolm Dunn, The Gardens, Dalkeith Palace, Dalkeith, N.B., because, besides the record of special appearances, they draw attention in some degree to the reasons influencing amount of Wasp attack. Mr. Malcolm Dunn notes, from his own personal observations during a long course of years, and at localities respectively in England, Scotland, and Ireland, the preference of Wasps for dry situations, and dry soils; also mentions the special districts of attack during the past season in Scotland, and of the enormous amount of Wasp presence observed by himself during a part of August in various of the southerly and easterly counties of England; and also notes some applications serviceable for destroying the nests, including cyanide of potassium as the most effective remedy known, but requiring great care in use, it being a rank poison.

Mr. M. Dunn wrote me on the 28th of September as follows:—
 “Wasps.—They have been an unmitigated nuisance in many parts of the country this season, but as a rule they prevail most in the drier parts of the country, and on warm and well-drained soils; hence in my six years' experience in Ireland, I never knew of them being nearly so plentiful as in the drier parts of England and Scotland.

“I was in the Co. Wicklow in the hot and dry seasons of 1869, 1870, and 1871, and although it is about the driest part of Ireland, and on a limestone gravel sub-soil, the Wasps were never half the trouble to us that they were in the Teme Valley, in Worcestershire, where I lived for nearly four years before going to Ireland. Coming to Dalkeith in the warm summer of 1871, I found the Wasps literally *swarming* here, although, as mentioned above, they were not troublesome in Co. Wicklow.

“We had *enough* of them here this season; but still I have seen them very much worse in previous years; and speaking generally for the Lothians, we have had no great cause for complaint, and escaped with comparatively little damage to our fruit.

“In some parts of Scotland they were undoubtedly bad, particularly round the shores of the Moray Firth, a district that shares with the Lothians in being the driest parts of Scotland. I heard more complaints from that district than from all the rest of Scotland, and I think Mr. Charles Webster, The Gardens, Gordon Castle, Fochabers, N.B., would be able to furnish you with some notes on the severe attack the Wasps made on the fruit in that district.

“I was in the south of England for a fortnight last month, and in

some parts of Surrey, Hants, Sussex, Kent, Essex, Middlesex, Herts, and Bucks, the country appeared to be a *perfect Wasps' nest*.

“A solution of *cyanide of potassium* is our *most effective* remedy; but being a *rank poison*, it must be carefully handled. Brimstone, gunpowder, gas-tar, paraffin, Stockholm tar, and other ‘remedies,’ are all more or less effective; but none are equal to the cyanide of potassium in its deadly effects on the Wasps, and with careful handling it is perfectly safe, and not costly.”

MORAY, N.B.—The following notes, with which I was favoured on October 4th, by Mr. Charles Webster, Horticultural Superintendent for the Duke of Richmond and Gordon, from The Gardens, Gordon Castle, Fochabers, N.B., contain much useful information. The points particularly noted are, that no especially large number of Wasps had been observed in the spring; the enormous number, and great amount of damage to fruit, ranging in date from the end of July until the second week in September, when the first frost occurred; also some remarks on the unusually large number of tree nests, observed chiefly on Larch and Silver Fir; and also number of nests in a given length of dry stone dyke; likewise some notes on measures taken to trap the Wasps. Mr. C. Webster wrote as follows:—

“So far as my own observation goes, there was not an unusual number of queen Wasps in the spring, nor did the past winter seem more favourable to preserve insect life than many former ones. It was about the last days of July that my attention was first called to the plague of Wasps, by their attack on the wall Cherries. We could find no protection from their attack upon this fruit, a large proportion being consumed by them. Some of the trees, when the nets were shaken, had the appearance, for a few seconds, as if a swarm of Bees had come off.

“As the different sorts of wall fruit ripened, such as Apricots, Peaches, and especially Plums and Jargonelle Pears, it was attacked by swarms of them. Even hard Apples and Pears (which had been picked by birds), and quite devoid of saccharine matter, were fixed on as greedily as some of the softer fruits. The plague continued from the end of July to the second week in September, at which time we had our first frost, cutting up Dahlias, Begonias, and other tender plants, and also putting a check to the quantity of Wasps.

“During the height of the attack, many thousands were caught by means of glass traps and bottles containing some beer, which we had hung on to the branches. It was also necessary to cover the ventilators of the vineries to prevent their ingress, otherwise they would soon have destroyed a house of fruit.

“There is a dry stone dyke or wall which partly surrounds our kitchen garden, and in it a great many nests were found. In a space of ninety-six yards, twenty-three nests were destroyed, but no suitable place seemed to be unoccupied by them. More nests were found this

year than usual in trees, chiefly Larch and Silver Fir, and many of the nests of large size, and should you desire a specimen, I do not think there would be much difficulty in procuring one."

DUMBARTONSHIRE, N.B.—The following short note from Helensburgh, Dumbartonshire, N.B., sent me by Mr. Robert Howie, on the 15th September, connects (like those of various other observers) a somewhat greater amount of Wasp presence than usual in that neighbourhood with the greater heat:—"As to Wasps, they are not at any time plentiful here. I think, however, we have had more of them than usual, although not by any means 'a plague.' I consider this quite accounted for by the greater heat we have enjoyed this season."

ARGYLLSHIRE, N.B.—More westerly, that is, in the Island of Islay, the Wasp presence was noticed as being much in excess of the usual amount of appearance, though not in the vast numbers in which the infestation occurred in many places.

In reply to my enquiries, Mr. R. Scot Skirving, of Foreland House, Island of Islay, Argyllshire, writing on the 14th of September, mentioned:—"We have had no such plagues as I have read of in the south of England"; . . . "but we have had our plague too. We have had twenty or thirty Wasps at least for one we have had in previous years. They invaded the house, and stung the ladies"; . . . "they jump up and fight the Wasps with a pocket-handkerchief, and so get stung."

Mr. Scot Skirving further noticed:—"During July, the Oban papers frequently referred to what they called the 'plague of Wasps all over.' They mentioned Mull as swarming with them." . . . "I think there is no difficulty in accounting for the great increase of insect life in Britain, it is the great heat we have had."

Relatively to his own observation of Tree-building Wasps, Mr. Skirving wrote me that in East Lothian he thought they nested in equal numbers in holes in the ground, and in trees; but that "at this place" (*i. e.*, the part of Islay under observation) he did not know of Wasps having been observed to build on a tree or bush. Later on, he kindly forwarded me the following letter on the subject, sent to him by Mr. P. R. Ballingal, of Eallabus, also in the Island of Islay, N.B., with the remark, that with him there were more woods and plantations to draw observation from, as well as shrubs and bushes.

Mr. Ballingal wrote as follows:—"Wasps.—This year they have been much more numerous than I have ever seen them, yet with you I would not say they have been a plague. The foresters told me early in the season they never saw so many nests before; and as to the garden fruit, they helped themselves to the most of it. I am surprised to hear you say you never saw a Wasps' byke in Islay; here they are very common, both in trees and ground"; . . . "about the size of a man's

head is the largest I have seen, and commonly more of the size of a yellow Turnip."

ORKNEY.—My other north British observation was very satisfactory as to absence of Wasp presence, and was sent me in the following short note, on October 18th, by Mr. Thos. McDonald, from The Gardens, Balfour Castle, Isle of Orkney, in reply to my enquiries:—"I am happy to say that I have not seen a dozen Wasps during my sixteen years in Orkney."

ENGLAND.

Yorks.—Beaumont Park Museum, Huddersfield. From Mr. S. L. Mosley, F.E.S., as a practical collector, as well as scientific entomologist, I had hoped just possibly to get a note of observation of the very rare *Vespa arborea*; but, as will be seen below, this was not the case, so that the only note of observation of this species in live condition which I can give in these pages, is from the specimens taken accidentally (not in connexion with their nest) by myself some years ago in Gloucestershire, and then identified by the late Fred. Smith, of the British Museum (see ante, p. 114).

Mr. Mosley wrote me:—"As to the Wasps, we have had a great many about during the summer, but not, I think, so bad as in the south. The great majority are *V. vulgaris*, but *V. sylvestris* is not uncommon. *V. crabro* does not occur here, though it has often been reported to me, but always turned out large female *vulgaris*, or nests of some of the tree species. I have never noticed *V. arborea*, not to know it."

Writing from Preston, Hull, Yorks, Mr. H. L. Leonard mentioned (as below) the great prevalence of Wasps in that neighbourhood, and also a method found serviceable for destroying the nests:—"Wasps.—We have had a most unusual quantity this year. A few years ago, I particularly noticed a very large number of 'pioneer' Wasps in the spring; these appeared to make for the kitchen, and were destroyed: during the summer following, I don't suppose I saw a score of Wasps in all. This spring, on the contrary, I only saw one 'pioneer' Wasp, and in the summer the ordinary Wasps were a positive pest, they were everywhere.

"Remedy.—I always fill an empty cartridge-case with about one part flour of sulphur to four parts of gunpowder, damp slightly, attach a lighted fuse, and place in the hole leading to where the swarm is located, in ten minutes every one will be suffocated."

NORFOLK.—The following notes with which I was favoured by Mr. Edw. A. Atmore, F.E.S., of King's Lynn, Norfolk, contain some very interesting observations on various points of the Wasp infestation. One of these is the trouble caused by them to men and horses in the

fields; another the species of Wasps mainly noticed, and large proportion amongst these of the *V. vulgaris*; also the observations of the method of Wasps in dealing with flies and other insects; and the serviceableness of Hornets in destroying the common Wasps.

On the 4th of October, Mr. Atmore wrote me as follows:—"Wasps have been very abundant in this district, particularly in the fen or marshland districts, where their ravages amongst the fruit have been, I believe, unexampled. In the marshland districts of Lincolnshire, I am told, on good authority, that they have been even more abundant large numbers of nests frequently occurring within a very small area. Cyanide of potassium has been largely used here for the destruction of nests. I can only report the occurrence of four species here (of course excepting *Vespa crabro*, the Hornet), viz., *V. vulgaris*, *V. germanica*, *V. rufa*, and *V. sylvestris*. Banks of streams and ditches have of course been more generally used by the ground species for nests; but many nests have occurred in old rockery of gardens, and beneath fences, and instances of nests in ground of open fields have also come to my notice. Nests in the latter situation have caused much trouble and annoyance to horses and men engaged in ploughing. Old roofs of houses have also been freely patronised for nests, especially by *V. germanica*. The nests of *V. vulgaris* have been most frequent: probably at least 80 per cent. of the nests here have been those of that species. *V. germanica* has been commoner than *V. rufa*, but nests of *V. sylvestris*, upon fruit trees and Currant bushes, have been fairly common. *V. sylvestris* generally is a rarity here, although I am aware it is generally common in the south.

"Wasps being so much to the fore this year, I have had opportunities now and again of making observations as to their insect-killing propensities. I have often seen them seize flies on the window with their mandibles, and retain them in the mouth for a long time as they fly round the room, or run up and down windows. I do not think that they generally kill flies as food for themselves, but I have watched them entering nests with flies and other insects, which seems to indicate that they are intended for consumption by their larvæ, or grubs.* Once I witnessed a Wasp seize a small white butterfly (*Pieris rapæ*) and carry it off, I suppose to its nest. Larvæ of Lepidoptera have also been destroyed by them here in large numbers; and certainly larvæ of Macro-Lepidoptera have not occurred this autumn in such numbers as I had expected to find them.

* This view is entirely in accordance with the peculiarities of the internal structure of the Wasps in imago condition, and with what is shown as to the nature of a part of the food of the larvæ, by the undigested remains to be found in the blind pouch when moulted off. See observations under the heading of food, at the latter part of this paper.

“Hornets (*V. crabro*) have also been unusually plentiful here, the nests, as usual, occurring generally in hollow trees. These powerful insects seem to be as fond of destroying Wasps, as Wasps themselves are of destroying flies. I have several times witnessed this habit of theirs.”

WORCESTERSHIRE.—On applying to Mr. J. Hiam, The Wren's Nest, Astwood Bank, near Redditch, with regard to what he might have observed of Hornet presence in the past season, he informed me that “Hornets,” *Vespa crabro*, had been more numerous than ever remembered in that locality, and also for a few miles round. Eight nests had come under his own observation, and he had heard of others being taken at a short distance beyond the extent of his own walks.

Later on, on November 9th, Mr. Hiam favoured me with the results of his further enquiries as to amount of Hornets' nests observed, and damage done by the insects, as follows:—“I find there were about a score of nests within a few miles that were known of, and doubtless others in woods and lonely places would escape observation. Considerable damage was done in gentlemen's gardens to wall fruits of the best sorts, and also to fruit in orchards, and in the fields, to cider fruit; but the latter has been so plentiful and cheap, that it is hardly worth taking into account.

“I have taken a large quantity of queen Hornets from various nests, some of which I have alive now (November 9th). This will materially lessen the number of nests next season, but from what I know of several colonies in inaccessible positions, in roofs of houses and otherwise, a large increase may be expected.”

Mr. Hiam further remarked with regard to the habit of the Hornets of stripping young bark:—“Near one Hornets' nest I noticed the young Ash sticks had been stripped in pieces of the bark all round, or in other cases in patches, which is not unusual, but for the exact purpose I am not quite certain, because the combs, and paper covering on the outside of nests, appear to be composed entirely of dead rotten wood, nicely blended in coloured layers. Hornets also take the sap oozing from wounds, whether caused by Hornets or otherwise, of the Elm, and also tap Dahlia stems, and suck the flowing sap.”

Some very good figures of shoots of Ash, and also of Birch, injured by removal of bark by the Hornets, will be found at p. 405 of the valuable volume by Dr. J. Ritzema Bos on animals injurious and useful in agriculture, horticulture, &c.* Dr. Ritzema Bos, speaking on the following page of the damage done by Wasps (including in this of course Hornets) in this way, notes that although the building

* ‘Tierische Schadlinge und Nützlinge für Ackerbau,’ &c., von Dr. J. Ritzema Bos. Paul Parey, Berlin.

material is chiefly of rotten wood, they will gnaw down to the sap wood of young branches or stems for the purpose, apparently, not only of using the torn off pieces of the bark for building purposes, but that they may suck the sap that flows from the wound. Ash is mentioned as preferred; after this Willow, Alder, Birch, Beech, Lime, and Elder. (In an instance where I had myself, together with my sister, the opportunity of watching Hornets at their operations in removing patches of bark from some Ash saplings by a pool in Gloucestershire, we were able to see them definitely sucking in the sap from the torn edge of the bark.—ED.) Necessarily, where much bark is taken, or the young bough, or sapling, completely ringed, much damage is done.

Mr. J. Masters, Hon. Sec. of the Evesham Fruit-growers Experimental Committee, writing to me from Evesham on the 11th of Sept., in reply to my enquiries, observed:—"It is singular, but here in our immediate locality we have had no more Wasps than in ordinary years. This, my opinion, is confirmed by that of others.

"The men have taken the Hornets' nests this year in my orchard. The nests were built in the cavities of two old trees. The powder-ball, that is, the paste made of wetted gunpowder, was applied to the hole; this ignited the filth or decayed wood, which gradually burned the interior of the tree, and destroyed the nests. Of course it killed the tree. The usual method employed here in taking Wasps' nests, is by the fizzy, or powder-ball."

GLoucestershire.—The following note refers chiefly to removal of already disturbed Chafer grubs by Wasps. During the latter part of the summer, I received a good deal of communication from Miss Dobell, of Detmore, near Cheltenham, regarding Chafer grubs (see ante, pp. 26, 27), which were injuring the grass roots on her land to such an extent that she was employing some men and boys to collect the grubs, which they were doing in great numbers; and about the 10th of September, Miss Dobell wrote me as follows regarding the attacks of Wasps on the Chafer grubs when collected from under the grass:—"I have been much interested to see that Wasps are wild for the grubs, and seem to bite them in half just below the head, and carry off something out of them to their nests. The men said they killed lots in the tins in this way.

"Last night, at seven o'clock, I went into the field to see if there were more places to do, and pulled out three or four grubs, and put them on the open space; a Wasp came at once and killed the grub in the way I mention, flew away, and came back for more."

With regard to Wasps' nests, Miss Dobell mentioned that up to the date of writing (10th September) none but ground nests had been noticed this year; but of the ground nests numbers had been taken,

and it was obvious many more nests must still be remaining, from the great number of Wasps that were still observable.

Mr. C. D. Wise, writing from the Toddington Orchard Company's Grounds, Winchcomb, mentioned:—"Wasps were a terrible nuisance to us in our vineries, and did an enormous amount of damage. I hope you will be able to give us some remedy."

CORNWALL.—From Coosenwartha, Scorrier, Mr. Geo. Thomas wrote me, on the 7th of September, regarding Wasps:—"They never were so plentiful in this county as at present, indeed they are a nuisance." . . . "I used to destroy them by screwing paper thus" (here a sketch was given of a piece of paper twisted into a funnel-shape.—ED.), "tarring the outside, and thrusting it in their holes, and in the night, pouring paraffin, and setting fire to it.

"But there are several kinds. The kind I am writing of we call the 'Apple-bee,' the abdomen is striped with yellow and black." Not being aware of this peculiar name for Wasps, I enquired of the daughter of a Cornish farmer resident here whether she had ever heard it, and she told me that until about four years ago (*i. e.*, until she came out of Cornwall), she never heard them called anything else. "There were Honey-bees and Apple-bees, and the Apple-bees built paper nests in hedges."—ED.

GUERNSEY.—The following notes, with which I was favoured by Mr. F. Hutchesson, 1, Queen's Road, Guernsey, notice prevalence of Wasps beyond the usual amount in the island, but still not in numbers sufficient to do serious damage:—"I think we are singularly free of Wasps here; this year they have certainly plagued us more than usual, with the result of spoiling fruit, especially Figs and Plums. They have been more numerous than I ever remember, but their numbers would not, I think, have been considered out of the way in an ordinary season in England.

"I have never heard of a Wasps' nest in Guernsey in a bush; here they appear to prefer old banks, and as the fields are nearly always fenced by a bank, they do not make their nests where they could be disturbed by horses ploughing. In fact, I think I may say that although Wasps have been more plentiful than usual, they have done no material harm."

KENT.—The following notes refer to number of nests observed, and also to methods found to answer for destroying them, and were kindly sent me on the 2nd of October, in reply to my enquiries, by Mr. W. Gardner, of Bekesbourne, Kent:—"I have deferred writing to you *re* Wasps until I could get some fairly reliable information, and I may say the pests have been destroyed or taken (I cannot quite vouch for every one of them being destroyed) to the extent of nearly two hundred nests

or, to speak more assuredly, between one hundred and eighty and one hundred and ninety.

“I think about half were taken, or supposed to be completely destroyed, by cyanide of potassium, mixed in the proportion of two ounces of cyanide to a pint of water; the others were destroyed by pouring in gas-tar, or a sulphur mixture, as they used to do formerly. My old gardener always used pieces of Elder tree, from which he had abstracted the pith, and they were filled with a proper admixture of brimstone, &c., but I have forgotten the proportion. They went off like a squib.

“My man who used the cyanide said it was wonderful to see the instantaneous effect it had on the Wasps, and we found that the best way was to give them some; the next day to catch the stragglers that had stayed out during the warm nights, and then dig them out, and crush all the hatching and unhatched larvæ. Indeed, even when using the tar, digging out is requisite to make sure of destroying them.

“I remember one case I had where the hole ran upwards, so I stopped the entrance, and then got a pointed iron rod, six or seven feet long, on which I put a piece of gas-pipe, about half the length or less, and then running the rod carefully into the ground, I soon found when I had come upon the nest. I then drew out the rod, and poured in a quantity of gas-tar, which effectively did its work.

“The cyanide process is very simple. We dip a piece of cotton wool in the mixture, and put it upon a pointed stick, and push it pretty well into the hole; of course it needs to be in the hands of a trustworthy person, being such a *violent poison*. Hornets, I am happy to say, I know nothing about, never having seen a Hornets' nest since quite a boy.”

The above observations of numbers and treatment of Wasps' nests, were taken from an area of somewhat less than six hundred acres of ground, thus giving an average of somewhere about one Wasps' nest to every three acres.

From Canon Court, Watlington, Mr. Edward Goodwin gave me the following observations, which note, amongst other points of interest (more especially as coming from a Wasp and Bee observer), that queen Wasps were not, so far as noticed, more observed than usual in the spring; also the greater strength of the nests, both in size and number of tenants, and that the autumn disappearance commenced earlier than usual in the season.

Mr. Goodwin wrote:—“With regard to the so-called Wasp plague, I send you the following notes as the result of my own observations. I believe there were *not* more queen Wasps in the spring than usual, but the fine warm weather enabled a very large proportion of them to establish nests before being destroyed by their various enemies. But

a far more noticeable feature than the number of nests, was the great strength (in number of Wasps) of each, the average size being larger than I have ever known before.

“We made a great onslaught on them in June; most people using cyanide of potassium, which I have myself used successfully for years. At one time they were certainly quite a plague. A large quantity of fruit of all sorts was destroyed by them, and few people escaped being stung.

“Undoubtedly Wasps do a certain amount of good in killing flies and other insects, but in my opinion it bears a very small proportion to the amount of harm. The autumn dwindling commenced unusually early,—at the beginning of August, or even sooner.”

In the neighbourhood of Farningham, a little village near Southfield, Dartford, Kent, three dozen nests were found within a radius of a quarter of a mile, and taken with turpentine and paraffin. (Contributed by Mr. F. O. Solomon, Lecturer in Agriculture of Durham College of Science.)

SURREY.—Birtley, Witley. The following note refers to one of the worst accidents from Wasp attack to horses of which I heard, and of this such exaggerated accounts were circulated, that on application to him as to what really had occurred, Mr. Thomas Collins, the Agent for the Earl of Derby, at the above address, kindly contributed the following information:—“The only way in which the Wasps have interfered with our agricultural operations, so far as I know, is by driving the horses and men from their work.

“We have ploughed through a great many nests; but on one occasion the horses were so stung that they tried to get away, and one of them fell into a narrow ditch just close to a tree, and the men had to cut the tree down to get the horse out, and even then, as he was on his back and could not turn, he had to be pulled out by main force. We found he had been stung in more than twenty places. His partner fared a little better, as we could find only about a dozen bumps on him. The man who was with the horses, and another who ran to his assistance, both got severely stung about the head and neck.”

(Observations as to the inconvenience caused by attacks of the Wasps to horses and men, will be found in the report of Mr. Charles Robinson, of Beeding (p. 129), and mentioned by other contributors.—ED.)

The Gardens, Lythe Hill, Haslemere, Surrey. Mr. Evans, a very careful and experienced observer, writing on September 9th, mentions the enormous prevalence of the pests, their early appearance, the damage caused there, the great number of nests, and effectiveness of cyanide of potassium for getting rid of them:—“In answer to your enquiry respecting damage, &c., of Wasps, I beg to inform you that

never in my experience in various parts of the kingdom have they done so much damage. The early dry hot spring brought out the queens at such an unusually early date, that the development of brood was strengthened. I may note that on March 27th, I took a nest from a Thuja tree, two inches by one and three-quarter inches, since that time one hundred and twenty-seven nests have been taken within the gardens. I have not found anything so effectual and easy as cyanide of potassium. The Gooseberry crop was completely cleared when approaching ripeness; quite two-thirds of the Pears have been damaged and destroyed; Apples about one-third; Plums about half." *

SUSSEX.—The following notes, kindly contributed by Mr. Charles Robinson, of Truleigh, Beeding, refer especially to farm damage, and inconvenience caused by Wasps, in respect of attacks on horses, and also in stings to labourers in the field; and likewise to benefit from Wasps destroying flies in cattle sheds, points on which Mr. Robinson's large occupancy of ground, amounting to two thousand acres, on the Sussex downs, near Brighton, gave him full opportunity of observation. Mr. Robinson wrote as follows:—"It is a fact that we have had a full share of the 'Wasp plague' in this part of Sussex, but except incidentally, I do not think that agriculture (as the term is generally understood) has suffered thereby.

"There have been several instances hereabouts of teams having been driven from the field when they have trod on, or ploughed up, Wasps' nests; and our Bean cutters got sadly stung at their work, it being almost impossible to handle the crop without also handling the Wasps that settled in vast numbers upon the Bean plants. Their object was evidently the pursuit of the Aphides with which the Beans were this year infested, and in preying upon these they were helping to rid the farmer of a most destructive enemy, though apparently they made but a small impression on the vast number of Aphides.

"The Wasps unquestionably destroy a great number of flies about the cattle-stalls, &c. I believe they prefer the blood-sucking variety, and often get these when they are gorged with freshly drawn blood from the beasts. The clumsiness of the Wasp in pursuit of active flies is sometimes curiously apparent, and if a door in the bright sunshine happens to be studded with nail-heads, about the size of flies, Wasps may often be seen trying to seize them.

"The 'real damage' they have done, and are doing, is to fruit, particularly Pears, and the higher qualities of Apples. Many of these

* Mr. T. P. Newman, of Hazelhurst, Haslemere, to whose kind co-operation I am indebted for procuring me most of the foregoing and following reports on Wasp presence in Surrey and Sussex, mentioned to me that the above Wasp damage was notwithstanding Mr. Evans having many thousand bags placed on the fruit.

latter are decaying and falling from being pierced by the insects." . . . " Since the Blackberry crop has ripened, I think the damage in orchards has somewhat decreased."—(C. R.)

Lowfield Nurseries, Crawley, Sussex. The following notes, contributed by Mr. J. Cheal, from the above address, give details of the severe damage caused by Wasps to fruit, as well as some observations as to their method of carrying on the ravages, and also (as in the two preceding reports) inconvenience from attack out of ploughed-up nests, and to men working on Aphis infested plants from Wasps attracted by them. Mr. Cheal noted :—" In the first place as to damage done by Wasps, we have had unusual opportunities of observing their habits this season, as we never before knew them so numerous.

" We have destroyed within the nursery over two hundred nests. There is no denying but that they have done a large amount of damage to the fruit, and we have now lying upon the ground underneath some of the Apple trees, large quantities of Apple skins, which have been completely hollowed out by the Wasps, scores of bushels having been destroyed. We have observed them very closely, but we have come to the conclusion that in no case could we positively say that the Wasps *commenced* the fruit unless the rind had been punctured in some way before.

" We have here a large number of birds, and the Wasps generally attack an Apple that has been previously pecked by them. This year we have also noticed that the Apples have been attacked by a large number of *small* birds, such as tits, and this has given the Wasps a greater opportunity of penetrating the fruit, but they have been by no means slow in taking advantage of previous depredations. They also appear to have a decided preference for certain *varieties* of Apples, and we were somewhat struck this year with the way in which, for a few days, they would swarm upon *one* variety, and then suddenly leave this for some other variety, which appeared to be more to their taste ; so much for Apples.

" As to Plums they did a considerable amount of damage to these, and there is no doubt that they punctured these without assistance from birds, &c. We had, in consequence, to gather many of our Plums before they were fully ripe. Grapes they have also very much damaged, and it has been needful to cover all openings in the houses with fine net, in order to exclude them.

" We think we should, in fairness to the Wasps, mention *one* instance in which we think their presence has been beneficial. The fruit stocks, especially Apples, have been very heavily attacked by Green Fly, and the growth of the plants being somewhat slow owing to the drought, these Aphides have also severely checked their growth, and we noticed during the prevalence of the Wasps, that they swarmed

upon these plants, and fed upon the Aphides. So thickly have they swarmed upon these fruit stocks, that our men in budding them have been frequently stung. We do not know of any operations having to be suspended in consequence of Wasps, and the only other serious interruption that we have heard of has been by the occasional ploughing up of a nest. Our own men did this once or twice, and in one case, the nest being a strong one, caused the horses to bolt, in consequence of the stings.

“The only remedy that we have tried, has been the destroying of the nests by either tar or cyanide of potassium.

“While upon the subject of Wasps, I may mention that we found in our nursery a fine specimen of the Tree Wasp (*Vespa norvejica*), which had built their nest upon a branch of Norway Spruce. I enclose a photograph of the nest.”—(J. C.)

Estate Office, Maresfield Park, near Uckfield, Sussex. Mr. Mark Sandford, with whom I was also in communication regarding attack of Rose Chafer grubs (see p. 26), contributed notes of great numbers of nests being observed, and very serious damage to fruit, as follows:—“In reply to your enquiry as to Wasps, I should think three hundred nests have probably been taken near us, say on three hundred acres of land. I have heard of no hanging nests. Heavy losses have been sustained, as some best fruits have been utterly eaten up; all our Peaches were eaten before they were ripe, we could *not ripen a single one*. All our out-door Grapes were eaten, and many of our best eating Apples cleared out, leaving only the peeling.

“Our men have taken many nests with torches made of gunpowder and tar, put in the holes, and set alight.”—(M. S.)

At Hollycombe, Sussex (post town, Liphook), the severity of the attack was still greater. I am indebted for the following contribution of information regarding this, which I think was about the worst of all the cases reported in presence of nests, besides damage to men and horses, to Mr. T. P. Newman, of Hazelhurst, Haslemere, who procured it for me, and wrote:—“Mr. J. Clark Hawkshaw, of Hollycombe, Sussex, reports that his bailiff has paid sixpence each for three hundred and seventy-six Wasps’ nests taken within half a mile of his kitchen garden: an additional payment was made afterwards for ninety-four more, some within the half-mile, and the remainder a little further away: four hundred and seventy in all. The damage to fruit, and especially to Grapes in the houses, was very great.

“Ploughing was stopped on one occasion, twenty nests being ploughed up in one field, and both horses and men were badly stung.”—(T. P. N.)

OXFORDSHIRE.—Kidmore Grange, Caversham. The following few lines, with which I was favoured by Mr. Martin J. Sutton, from the

above address, are in reply to an enquiry of my own, whether the great complaints regarding Wasp presence were over-stated, and show the prevalence of the pest in that as in many other localities. Mr. Sutton wrote me:—"There is no doubt whatever as to the 'Wasp plague' having been most serious, fruit having been destroyed wholesale, and people being in fear of their lives from the invasions of their houses by these pests. So numerous have they been at our own table, that it was difficult to take food on our fork without putting a Wasp in the mouth."

HERTS.—St Albans, Torrington House. Although in my own house I believe we were much less plagued than in many other places, I can bear witness to the Wasps being exceedingly troublesome, and at mealtimes a dextrous well-aimed pat with the back of a spoon, which would send the pest down without escape into the syrup, or whatever it might be, on which it was trying to maraud, was much too often required. Thus the Wasp is incapacitated for a minute, and may be picked out and destroyed. A neighbour, however, was in some danger from a sting of a Wasp, given inside the throat whilst being swallowed in some beer.

In the town, the Wasps were excessively troublesome. At the Misses Randall's, one of the chief stationer's shops, the Wasps flocked in in such numbers, that for comfort of the customers the doors were obliged to be kept as much shut as could be managed.

Mr. Strofton, of Chequer Street, St. Albans, one of the leading grocers of the town, informed me that he had not known the Wasps so troublesome for many years as they had been in the past season. They swarmed in at the door in vast numbers, and got into the sugar drawers, and carried it off in quantities, amounting altogether to some pounds. The jam-pots also were ravaged at where open to attack, and often cleared out some inches down. By way of trying an experiment as to extent of plundering, Mr. Strofton took the cover off a 2 lb. pot of jam, and left it exposed, and by the following night the whole contents had been removed. The Wasps had not given much annoyance by stinging, neither had they done any observable amount of good as to clearing away flies.

They appeared to have as good knowledge and memory in finding their way to the sugar drawer as in finding their way back to the nest, for whilst I was enquiring as to their habits, a Wasp flew in at the door, went behind the counter, and, before I could move a few steps to watch operations, had made its way into a sugar drawer.

Mr. Strofton informed me that the method of trapping he found answer best, was to partly fill rather small bottles, such as soda water bottles, with a mixture of beer and sugar boiled together, thus he had caught quarts of the plunderers.—Ed.

At the butcher's with whom I deal (Mr. Steabbens of the Market Cross), who has a large shop, the Wasps were unusually plentiful. They were said especially to come to the newly cut meat as, for instance, to the freshly cut end of a leg of mutton. They had not been observed to show any particular preference for liver, but sheep's hearts especially attracted them. In reply to my enquiry whether they merely sucked the juices, or carried off pieces of the meat, the reply was, "Oh, pieces." They were not considered to have lessened amount of flies, certainly not of blow-flies.—Ed.

IRELAND.

Kylemore Castle Gardens, Kylemore, Co. Galway.—On the 5th of October, Mr. W. Farmer, writing from the above address regarding the presence of Wasps in the above district during the past summer, mentioned:—"Wasps have been unusually plentiful here this year, but as a rule they are very scarce, causing but little damage to fruit crops, and although they have been unusually plentiful this year, they cannot be called a pest, attacking only damaged Plums, over-ripe Gooseberries, &c. I know of only two nests, but as they have been in no way troublesome, I have not looked particularly for them.

"The wet boggy nature of this district, and the heavy average rainfall we have here, no doubt keep the Wasps very scarce here."

From the Connemara Basket Industry, Letterfrack, Co. Galway, a locality very near the above mentioned, Miss Sturge replied to my enquiries as to Wasp appearances, on the 22nd of September, as follows:—"With regard to the question of Wasps, we have had very few this summer here, for there is no fruit in Connemara, and the winds do not suit the Wasps very well." Miss Sturge also mentioned that about two miles off, where there was a large garden, and more shelter and cover for the Wasps, and also more trees, she had seen a number of Wasps' nests in the ground. "Here," Miss Sturge remarked, "I am on the bog-land, unsurrounded by trees, and without anything for Wasps to feed on."

A few Continental observations of Wasp presence.

NETHERLANDS.

State Agricultural College, Wageningen. On the 20th of October, Dr. J. Ritzema Bos, Professor at the State Agricultural College, was good enough to tell me, in reply to my enquiries, that:—"Wasps were also very inconveniently prevalent in the Netherlands, and also in Germany, at least in the Harz, where we were in August.

“*Vespa vulgaris*, *V. germanica*, and *V. media*, were very prevalent here, indeed the Grapes were eaten by them on a large scale”; also, in one place, a little boy died in consequence of being stung by a great number of *Vespa crabro* (our English Hornet).

NORWAY.

CHRISTIANIA.—Dr. Schøyen, State Entomologist, Christiania, was also good enough (on the 31st of October) to send me the following information, to which he added a most interesting account of such unusual prevalence of Wasps some few years back so far north in the Arctic circle, that I have great pleasure in inserting it, with many thanks also for Dr. Schøyen’s spirited translation. Later on, Dr. Schøyen favoured me with some further observation of Wasp presence in a more southerly part of Norway during 1893.

Dr. Schøyen wrote me first on October 31st:—“As to the Wasps, they have not, so far as I know, been troublesome this year in our country. Last year they were more numerous than in this year, at least here in the south-eastern districts of Norway, indeed more than usual abundant, though not in such excessive numbers as sometimes may happen even in more northern localities.

“In the years 1883—1884, there was quite an unusual prevalence of them in the Arctic Norway, especially at Tromsø and other islands in the vicinity. Mr. J. S. Schneider, Conservator at Tromsø Museum, writes in the Swedish ‘Entomologiskt Tidskrift,’ 1885, pp. 148, 149, about this matter as follows:—‘Who can tell all the tears which these wicked animals have squeezed from the poor children, or the swearings which the mowers have thrown out, the half-shut eyes, and the swollen hands and cheeks, which have shown forth in the autumn months of these two years? Perhaps this may appear as an exaggeration, but it comes, however, pretty near the truth. They built their nests everywhere, in the earth, in stone walls, behind the wainscottings of the houses, under garden benches, on the trees; it swarmed with Wasps on all the flowers and bushes, the windows were filled with them, they crawled on the plates of the dining-tables, licked of the dishes with preserves, crawled under the clothings, and in the hair, and did not at all spare the ladies! When one was going in the woods, a humming warbling was heard, which is still sounding in my ears; Wasps everywhere, it was almost a despair,’ &c.

“I have not in the southern districts of our country anywhere seen the Wasps so exceedingly numerous as they must have been in Tromsø in the said years. The species occurring here are: *Vespa crabro*, *media*, *saxonica*, and var. *norvegica*, *holstata*, *vulgaris*, *germanica*, *rufa*, and *Pseudovespa austriaca*.”—(W. M. S.)

V. holsatica, of Fab., is one of the synonyms for our own *V. sylvestris*, Scop.; our *V. norvegica*, Fab., is also the *V. britannica*, of Leach.

At the beginning of December, Dr. Schöyen kindly sent me the results of some subsequent information received as to the unusual prevalence of Wasps in the past season, and the damage done by them, especially to Cherries in the neighbourhood of Laurvik, a town about sixty-five miles S. S. W. of Christiania, as follows:—" . . . I have also a short communication to give you about the Wasps. As I told you before they have not this year been unusually abundant here in the neighbourhood of Christiania, but now I have been informed that they have been so in the neighbourhood of the town Laurvik (more southwards), where they have done considerable damage upon the Morel trees, eating away all the fruits, and leaving only the stones. Such damage has not been observed in the place since many years, but the Wasps were this summer flying most plentifully in the trees."—(W. M. S.)

GENERAL SUMMARY.

The foregoing British observations show presence of all of our seven kinds of Vespidae, commonly known as "Wasps" (excepting of the rare *V. arborea*). Of these, the *V. vulgaris*, or Common Ground Wasp, appears to have been the most observed, although both the other kinds of Ground Wasps, *V. germanica*, and *V. rufa*, were present. Of the Tree Wasps, the *V. sylvestris*, was noted by two entomological observers, respectively, as not uncommon, and as fairly common, and a nest of the *V. norvegica* was also reported. The *V. crabro*, the Hornet (a true Wasp, although not popularly considered as such), was "plentiful" in some localities, but only reported from a few.

The Wasps' nests, besides being much more numerous than in ordinary years, were noticed in some instances as being of greater than the customary size, and more numerously tenanted. From contributors who especially attended to the numbers of nests destroyed, or kindly obtained information for me, I had notes of destruction of over one hundred and eighty nests on somewhat less than six hundred acres of land; two hundred nests taken in one nursery garden; an estimate of about three hundred nests taken on three hundred acres; and in one instance, where a bonus of sixpence per nest was given, three hundred and seventy-six nests were taken within half a mile of the kitchen garden, which was the centre of operations, and later on payment was made for ninety-four more, within the same area, or a little further away,—four hundred and seventy in all. Other notes gave twenty nests ploughed up in one field; three dozen observed, or taken, in the radius of a quarter of a mile; twenty-three nests in ninety-six yards of dry stone wall, or dyke, &c. Of Hornets, in one locality, nine nests were

known of within the limits of "a ramble," and twenty in the more extended area of a few miles.

It is worth noting, that from two well qualified observers respectively almost at the north and almost at the south of the area reported from, namely, localities in Co. Moray, N.B., and Kent, and also from a station midway, namely, Hull, I had information that *no* unusual amount of appearance of queens in spring preceded the very unusual amount of Wasp infestation afterwards.

Where the observers expressed an opinion as to the cause of the very unusual prevalence, it was referred, as indeed seemed clearly demonstrated, to the unusual weather in the spring being so entirely suitable for satisfactory settlement of the queens.

In some places the attack was noticed as passing away before the customary time of Wasp disappearance in ordinary years. In regard to *benefit* or *injuries* received from the Wasp presence, the evidence shows unquestionably preponderance of the latter.

We have some benefit from the Vespidae destroying other insects, thus Hornets kill Wasps, Wasps kill flies and other insects, and insects in the maggot stage, if of kinds acceptable to them, or like the Chafer grubs, mentioned at p. 125, if exposed so that the grubs are accessible. Two notes are given of service in attacking Aphides, but in one of these it is mentioned that the Wasp attack apparently made but a small impression on the amount of the Aphides; and that the labourers amongst the Bean crop got "sadly stung"; and in the other, stinging of the workmen is mentioned as "frequently" taking place.

Taking flies round the cattle stalls is mentioned by one observer, but though doubtless they may do good by clearing flies in butchers' shops, I have no observations sent in of the Wasps giving themselves the trouble to collect food of this kind where juicy fresh cut surfaces of meat, or where (as in grocers' shops) sugar and jam, or other acceptable provisions, were more easily attainable, and (where I had opportunity of enquiring) no good service of the Wasps in this way had been noticed.

The great amount of injury inflicted by them in serious losses to fruit-growers, and pain, risk, and inconvenience, by their extraordinary amount of infestation in houses, and their attacks (or onslaughts, rather) on men and horses when disturbed in the fields, are matters of very demonstrable evil. Notes of these being given in the foregoing pages, it is unnecessary to repeat them; but where good fruit, and it will be noticed how, in some instances, the best sorts and choicest kinds are selected, is destroyed in bushels; bags used by thousands to protect it, and possible entrances into fruit-houses, or vineries, secured by netting, &c., that there is very demonstrable loss and trouble.

The applications named as useful in destroying nests are brimstone,

gunpowder, gunpowder and sulphur damped, and fired so as to suffocate the swarm if in the ground, gas-tar, Stockholm tar, paraffin, and cyanide of potassium. Obviously any kind of application which will destroy the Wasps without allowing exit of the irritated legions to sting the operator, will serve the purpose, in case this is not accompanied by danger, as from use of gunpowder in careless hands, or what is a still more serious danger, the risk from use of deadly poison without proper precaution. Cyanide of potassium is certainly reported as the most approved remedy, but its deadly nature as a poison requires most careful consideration. The store of it should always be kept under lock and key, and whether used dry or in solution, the packet or bottle should always have a large and legible label POISON, and the application should be always entrusted to known careful hands.

Very often destroying Wasps' nests is a bit of amusement at odd times to any boys that may be about, and the more smell, and fire, and noise that can be made, the greater the pleasure. But for quiet, safe work that is effective in destroying the nest, I have found sending a man round with a pot of tar, and having a ladle of it poured down the holes, answer very well. If properly applied, no Wasps can get up to sting the applier, and the Wasps within die of starvation. In case, as sometimes happens, there are two roads down to the nest, this matter must be looked to, but I have generally found it answer well.

No method of taking hanging Wasps' nests has been given in the preceding notes, and the rough practice of burning the nest, and a portion of the hedge with it, is entirely objectionable. I have often taken them with perfect safety myself by simply having strong tan leather gauntlet-topped gloves, with linen tops sewed on to them, down which I could pass my hands, and then had these tops safely tied round over my sleeves between the elbow and wrist. Thus no Wasps could hurt my hands, and my head was defended by a large strong piece of muslin thrown over the top of a broad-brimmed hat, so that it hung well down all round, and the lower edge was securely fastened by pins round the shoulders and across the chest.

It is necessary to have a broad-brimmed hat to keep the sort of veil well off the face and nose, and for material, I preferred the patterned muslin, or net, or lace, as it is called, of an old window-curtain, for the differences in material, and different thickness, prevented the first rush of all the Wasps striking so directly and audibly at my hat. It may be that some people would not mind it, but the first minute of work with hundreds of Wasps endeavouring to sting was always a time of intense nervousness. I would not advise anyone to try the experiment unless they can be thoroughly trustworthily pinned up, or the results may be serious. But for common purposes, the plan often saves a deal of trouble if a nest is wanted out of the

way at once, and the convenience of people who may possess beedresses, and will lend their services, are not at hand.

If, as may very likely be the case, the disestablished Wasps start a new house, as near as possible to the site of the former one, this will require destroying. In the course of experimental observation, I have known the Wasps of a removed nest rebuild from the very beginning four times, but never more than this, and these re-establishments are not of the importance of the original home.*

For catching Wasps, no plan seems to succeed better than hanging bottles (as noted by observers) partly filled with a mixture of beer and sugar. But where there are long ranges of Peach walls, or walls with fruit such as the Wasps delight in, I have seen glass-traps also answer very well indeed. These were made by taking a common square hand-glass with a pointed top, and a finger-hole just at the highest part. This glass was set on four bricks, one beneath each corner, so as to raise the glass by the depth of the brick from the ground, *not* by the width, which would allow too much space. On this lowest glass another is placed, taking care that any opening round the edge, where the upper glass rests on the lower one, is well closed with moss, and the finger-hole at the top of the upper one (*not* of the lower one) also carefully closed.

All that is further needed is to throw some fruit, such as the Wasps like, beneath the trap. The Wasps will go to it readily through the opening between the glass and the ground, but coming away is a very different matter. Then they usually fly upwards, and, passing through the open finger-hole into the upper glass, they are trapped, and perish. I have seen a deep layer of flies and Wasps thus trapped, to the great saving of the fruit on the adjacent trees.

For prevention of entry of Wasps into vineries, though the necessity of the matter is alluded to in the foregoing observations, no precise details have been given, I have known it answer quite well to fasten muslin, such as old window-curtains, to the edges of the lights and the framework to which they fitted when the lights were closed. If this

* No observations have been sent in on one point which touches us all very nearly,—how best to lessen pain and injury from stings; therefore the following extract from the work of my brother, Dr. Ormerod, on Wasps, may be of interest:—“Ammonia or soda will sometimes relieve the pain, and chloroform more certainly and speedily should it be at hand. Ipecacuanha is a favourite Indian remedy. But the best way is gently to withdraw the sting, and suck the wound if we can get at it, and then to leave it alone. Some persons swell very much after a sting, and for these rest, and a good dose of purgative medicine, are the best remedies.” Some few words are added on the importance of leaving the wound itself alone, that is, not teasing or squeezing the part. See ‘British Social Wasps,’ by Edw. L. Ormerod, M.D., p. 14.

is done carefully, there is little damage from the tacks (used to fasten the muslin) to either the paint or wood-work, but care must be taken to allow plenty of muslin, or the lights will necessarily not open as wide as is needed. Also the muslin must be so arranged as not to get in the way of the lights being closed, or to allow apertures which the Wasps will almost certainly discover.

The food of the Wasps, taken in the straightforward common sense view of what they swallow, or carry off, we all know well. For this, insects in perfect or maggot state, whole or chopped up for convenience of carriage, are a regular article of consumption; meat also is used, and I have myself watched a Wasp carefully detach a filament of herring, and pack the long piece away into a small parcel beneath what may be called its chin, for transportation. Fruit, sugar, sweets, and other edible materials, and for definite drink, a sip of beer, or beer and sugar, are all notable articles of dietary, and so also, to the sorrow of our bee-keepers, is honey. Also in the case of the large species, known as Hornets, the juice flowing from young bark, which they have gnawed down to the quick, forms an additional article of diet, given by an additional department of mischief.

But though the distinction is fine between an article of food swallowed for the creature's own use, and an article of food swallowed and wholly or partially restored for use of the young which require victuals (and also victuals more or less prepared) to be brought to them, still this point has to be considered in regard to Wasp food.

Researches have shown that in the larva of the Wasp, the food canal, or bowel, has not an external vent, but opens into a blind pouch, and it is stated that when this, with its black contents, are thrown off, as at the second moult of the grub, this mass will be found to be composed of various substances, amongst which scales, hairs, and other fragments of insects, and hairs of vegetables, are recognizable.*

I have not myself seen the operation (said to take place) of the nurse Wasps, or workers, restoring drops of their collected prey from their own insides, and administering the proceeds in small drops to the maggots; but from my own experience in Wasp larva feeding, they seemed quite ready to swallow anything pleasant and available.

Those who wish to follow these matters up, will find them, and almost everything that can be thought of in Wasp economy, in the various special papers that have been issued for a great length of time, successively filling in the wanting points of the previous observations. In such of the preceding notes as refer especially to life-history, I wish it to be particularly to be borne in mind by my readers that I have only given a bare outline of the Wasp economy. To enter on details

* See 'Social Wasps,' by Dr. Ormerod (previously quoted), p. 227.

of lesser females, under what circumstances the young of a nest replacing a destroyed one may produce only drones, and really countless details besides, would be out of place here. Neither has it seemed desirable to enter on the Wasp parasites, which play a helpful part in keeping them in check, and especially the "Wasp-nest Beetle," as it is sometimes called, the *Rhipiphorus paradoxus*, of which the larva feeds on the young Wasp larva in its cell, and changes to beetle condition there, so that when in due course the Wasp should be expected to come forth, instead there appears this singularly shaped beetle, with its long compressed body, wing-cases shorter than the body, and separated from each other at their pointed tips, and also not covering the wings up to their extremities. These are, or were, formerly considered to be of rare occurrence, but where a Ground Wasps' nest had from some cause or other passed the ordinary bounds of size, I found them once in great numbers, and a few elsewhere.

To some who are not called on to suffer in person or in pocket,—who have leisure to sit quietly, so as not to "molest" the Wasps, and whose daily bread does not depend on working, hot in person and hurried, and irrespective of Wasp presence and convenience, or whose property is made off with, and their staff of men and horses perilled,—it may appear a proof of fine feeling to talk, or write, of the tender affection of the Wasps for their young, and their *unpaid* labours. But to those who are otherwise situated the case appears materially different, and I should certainly say that where other means fail (in cases of great infestation like that of last year, namely 1893) it is well worth while to offer a bounty of a few pence per nest destroyed, which is a method of prevention and remedy which often answers very much more effectually than more elaborate arrangements.

P.S.—In the course of conversation with Mr. G. H. Carpenter, Consulting Entomologist of the Department of Agriculture of the Royal Dublin Society, Kildare Street, Dublin, whilst the above pages were going through press, he drew my attention to two females of the rare *Vespa arborea*, of which species the presence had not been previously recorded in Ireland, having been sent to him in the past season, 1893. The specimens were amongst a number of female Wasps captured in April and May by Mr. R. M. Barrington, near Bray, Co. Wicklow, and forwarded by him to Mr. Carpenter. The specimens were subsequently examined by Mr. E. Saunders, and considered by him to be "certainly" *V. arborea*. For the above information, with notes by Mr. Saunders, see also Ent. Mo. Mag. for July, 1893, pp. 166, 167.

WILLOW.

Small Chocolate-tip Moth. *Clostera reclusa*, Fbr.; *Clostera pigra*, Hufn.



CLOSTERA RECLUSA.—Moth; caterpillar (after W. Buckler); cocoon of spun-up leaves from life.

On the 8th of June, Miss Sturge, of the Connemara Basket Industry, Letterfrack, Co. Galway, Ireland, wrote to consult me regarding insect injury that had appeared amongst her Osiers. Miss Sturge mentioned:—"I have been advised to ask you if you could tell me how to deal with a small grub that has attacked, and is, I fear, destroying, my fine Osier crop. I am living in Connemara for the purpose of starting a basket industry amongst the people.

"I have been trying the experiment of planting some of the finer varieties of Osiers on my land in order to avoid having to import them. The dry weather does not suit them, and lately they are covered with this soft white sticky stuff like soap-suds. I am afraid they will all get destroyed."—(S. S.)

On examining the specimens sent, I found that two attacks were present. One was that of the "Cuckoo-spit" insect; but it was obvious, from the condition of the leaves, that something which was devouring these was also present, and I begged for further specimens. These Miss Sturge sent me on June 20th, and left no doubt as to presence of "Cuckoo-spit." The other attack was of a small black, grey and yellow moth caterpillar, which seemed to have been damaging the

leaves considerably, and proved on examination to be larvæ of the *Clostera reclusa*. Only one of these was observable on receipt, for the others were spinning, or had spun, the Osier leaves together as shelters temporarily, or for pupation. In one instance, the head of the little caterpillar was observable moving from side to side almost as fast as it could stir in forming its web and leaf shelter.

A few days later, Miss Sturge forwarded some Osier shoots for examination. On these the leaves were in some instances almost eaten away by the caterpillars, so that only about a quarter, or less than that, of the lowest part of the leaf might be still remaining. In other cases the side of the leaf was so eaten away as to leave only the mid-rib, with remains of leaf at distances. So far as appeared by the specimens sent, the damage was chiefly to the leafage towards the end of the shoot, and the terminal leaves were especially chosen for spinning together.

In her letter accompanying the specimens, Miss Sturge expressed fear lest her Osiers should be destroyed by the attack, and enquired whether, if she was to cut off the tops of the Osiers with the grubs in, this would save the lower part, and I replied that if at any reasonable cost the little bunches of spun-up leaves with the contained caterpillars could be nipped off and *destroyed*, that this might certainly be expected to make a deal of difference in danger of recurrence of attack.

The caterpillars, until they were changing colour for the chrysalis stage, corresponded fairly well with the description given in Newman's 'British Moths,' p. 223, as having a broad grey stripe down the middle of the back, this stripe being varied with yellow markings,* and also having a central velvety spot on the fifth, and another on the twelfth, segment. On each side of the grey stripe is a broad smoke-coloured stripe running along each side and the under part of the caterpillar; legs and sucker-feet are also smoke-coloured; but between these and the side smoky stripe is a broad line, or narrow stripe, of black and yellow spots. The head is black or dark; the body hairy.

The first few specimens which I had at the end of June being just about full growth, I had little opportunity of watching them through their changes from the characteristic colouring; but later on, beginning about the 11th of September, I was able to observe the gradual change of the autumn brood from the commencement of alteration of tint up to pupation.

The caterpillars were then about an inch in length, and the change began by the stripe along the back becoming of a more uniform tint,

* My specimens were more marked along the back with black spots, or small lines, see figure, p. 141, copied from figure 1, plate xxxvii, of 'Larvæ of British Butterflies and Moths,' by W. Buckler, Vol. III. Ray Society.

the grey becoming yellower, and the black markings, intermixed with the paler tints, fainter. In a day or two, the side stripe beneath the black stripe became orange colour, and (above) the segments in front of the most forward black spot on the back became orange yellowish, those behind it with orange yellow bands across, so as to give a general yellowish appearance to the back. On the 15th, the only larva remaining unspun-up had further changed to the stripe above being reddish brown, with orange or yellow marks, the side stripes orange and reddish brown, and the colour beneath of the same shade of brown as the ground of the long back stripe.

At this date all the larvæ I had were either on the point of spinning, or had spun leaves together for pupation. The open space between the leaves being filled with web, or rather a kind of gummy film, with some thicker threads dispersed irregularly on the surface.

On examining the spun-up leaves at date of writing (January 12th, 1894), I found the pupa of a rather dark red brown colour, with much darker wing-cases and head end, lying within the web. The first brood is stated (see Newman's 'British Moths') to be full-fed about the 5th of July; the second at the end of September; "then spinning a web amongst the leaves of its food-plant, and turning to a chrysalis in the retreat thus fabricated, it remains in that state throughout the winter."

The moth appears in May and August, and is popularly known as the "Small Chocolate-tip"; scientifically the name is *Clostera pigra* (Hufn.), or *C. reclusa* (Fb.). The latter name is given in South's list, p. 5, only as a synonym. The shape and markings of the moth are given at figure, p. 141. The colour of the fore wings is purple grey, browner grey, and darker towards the hind margin, with various markings and transverse pale lines; the hind wings dark brown-grey.

The eggs were given by Dr. Ernst Hofmann as flat, hemispherical, and of a red flesh colour. The food of the caterpillars is given by various writers, respectively, as the Dwarf Sallows, *Salix caprea*, and *S. cinerea*; as Willows and Aspen; and also by Dr. Kaltenbach, as found by himself in late summer, as on low growths of the *Abele*, or White Poplar, and the Grey Poplar, *i. e.*, *Populus alba* and *P. canescens*; and I have myself found that, when other food was not accessible, specimens in confinement would feed on leaves of Weeping Willow.

The species is considered to be widely distributed, both in England and Ireland, and it is also a Continental kind.

PREVENTION AND REMEDIES.—For prevention of recurrence of attack, it cannot fail to be of use, when the first brood of caterpillars are spinning up their leaf shelters in which to turn to chrysalids about the beginning of July, to have these little bunches of leaves picked off and

destroyed. To do it effectively, some one interested in the success of prevention would do well to examine about the middle of July, and see whether the caterpillars had gone through the change to the chrysalis condition. It is important to be sure of this, for at first, if disturbed, the caterpillars would be very likely to come out of their shelters, and little good might be done by the gathering of their spun-up leaves. But as soon as the change has taken place the bunches may be collected and burnt. This would greatly lessen the amount of the moths to be expected in August to start the second attack, and in case of this occurring, any leaf-nests should be again picked off that are observable on the Osiers about the end of September, or later; or if it is found they have fallen at the time of fall of the leaf, any measures that are available should certainly be taken to get rid of these.

What is really practicable for the purpose, probably only practical Willow growers can say. Any chemical dressing, such as lime or gas-lime, in quantity to injure the chrysalids might hurt the Willow roots, or the chemical effect might alter the pliancy of the shoots. If the state of the ground allowed the surface rubbish to be scraped together and burnt before the ground was cultivated in whatever method is requisite, this would get rid of a great many; and it would be well also to search on the Willow stools, at the bottom of the cut-back shoots, for what may have lodged there.

With regard to *remedy* when the caterpillars are ravaging on the shoots, the matter is very difficult. Miss Sturge, in her letters to myself, mentioned, in reference to hand-picking, that the attack was really terrible, so that hand-picking only cleared some amount of the many thousands.

Probably the only effective way to treat them would be to spray with Paris-green, from a Knapsack Sprayer, which could be carried on a man's back, and worked by him by means of a hose.* Where there are objections to the use of Paris-green, it would be worth while to try washes of a mixture of soft-soap and mineral oil, which could be prepared at home or purchased. The mixture sold under the trade name of "Anti-pest," by Messrs. Morris, Little & Son, Doncaster (see *ante*, p. 37), would save much trouble in mixing.

Water alone, if cold, sometimes does good in clearing caterpillars in hot weather, and this would also be beneficial in clearing the Cuckoo-spits mentioned at p. 141. These insects are so generally known that they do not seem to require a special notice. Most of us know them in their fully developed state as little greyish or brownish

* All requisite details are given in my pamphlet on 'Paris-green,' procurable, price 2d., from my publishers, Messrs. Simpkin & Co., Stationer's Hall Court, London, E.C.; or I would have pleasure in giving it myself to any applicant.

insects, with lighter markings on the upper wings, which are deflexed, a quarter of an inch in length, or thereabouts, and with the power of taking tremendous leaps. From this habit, and their somewhat frog-like shape (in miniature) they gain their common name of “Frog-hoppers.” The not pleasing name of “Spittle Insects” is given from their habit of living in their early stages in a little mass of frothy-like moisture, an excrementitious shelter for themselves, supplied by the great quantity of fluid which they draw from the shoots (sometimes exceedingly to the injury of the growth) with their suckers. In their early stages they are of the same shape as when they become perfect “Frog-hoppers,” but without wings, and also of a pale whitish or greenish colour. Scientifically they are Cercopidæ; specifically the *Aphrophora spumaria*, Germ., the *Cercopis spumaria*, L. They are especially injurious to Willows. In garden treatment, I have found heartily applied drenchings of water very useful for getting rid of them.

“Pebble Prominent” Moth. *Notodonta ziczac*, L.



NOTODONTA ZICZAC.—Moth and caterpillar, life size.

In the course of the communications sent me by Miss Sturge, from the Connemara Basket Industry, Letterfrack, Co. Galway, I found, early in September, that, in addition to the moth infestation mentioned in the preceding pages, and various other Willow pests that were doing damage, the curiously shaped caterpillar of the *Notodonta ziczac* moth (figured above), so-called from the peculiar zigzag position which it sometimes assumes, was also present.

The slight descriptions which are commonly given of the colours of the larva are very little help, and I had no opportunity of observation until the larva was an inch and a half long, therefore I give a few notes, more particularly of the early stages, from the observations of the late Rev. John Hellins, published in ‘Larvæ of British Butterflies and Moths,’ by the late W. Buckler, Vol. II., pp. 152, 153 (Ray Society).

The egg is stated there to be what is called button-shaped, flat below; one twenty-fifth of an inch across; shell finely granulated; colour greenish white, afterwards white. Larva at first with a large black head, yellow body, and small hump on twelfth segment, otherwise

smooth. After the first moult, the two sharp humps on the back also appear, accompanied by variety of marking, as a whitish grey colour along the back, with darker stripe, dark streaks on the side, and the belly dusky, &c. At the third moult several caterpillars under observation were found to show a pink tinge.

Of the subsequent change, Mr. Hellins mentions:—"The full-grown larva is generally handsome, but varies a good deal in colouring; I have short notes of one which was lilac above, dark brown below, the hump on twelve, orange red with yellow streaks, a yellowish line along the spiracles." Another variety very fully described had "the colour mostly a mixture of pale delicate grey and pink," varied with orange patches, pale yellowish streaks, &c.; and a third variety was paler still.

In my own specimen from Connemara, which appeared to be fully grown, the colouring most resembled the first of Mr. Hellins' three varieties, mentioned above, in the general colour, which was pinkish or purplish, but brown or lurid below. The dorsal humps, or bluntly pointed tubercles, were brown before, edged with a pale line, and a dark stripe ran along the back, from the brownish head to the humps, paler on the segment next these tubercles.

The segments beyond the fourth sucker-foot were mottled with bright rusty and yellow colours, disposed in two short broad curved bands pointing upwards, the upper slant of the caudal segment pinkish; a white line down outside of fourth proleg, faint white transverse lines on sides, and two faint white lines along back, from second dorsal hump to the hump near the caudal extremity. Altogether this full-grown larva was certainly, as Mr. Hellins remarks of some of his specimens, a very handsome creature.

The autumn brood of caterpillars are stated by Edw. Newman to "spin their slight cocoons on the surface of the earth, and to remain in the chrysalis state all winter."

The moth is double-brooded; but as from comparison of observations of different writers, British and Continental, it appears that the moth may be found from April to July, and the caterpillars from June to September, it appears as if for all practical purposes, the presence of the infestation might be considered as pretty constant during the warm season.

The moth is of the shape and pattern figured at heading, with a tooth at the hinder margin of the fore wings, which are chiefly ochreous brown, with a large pale grey blotch occupying about a third of the middle part of the fore edge, and various markings forming an eye-like spot at the tip of the wing; the hinder wings have a dingy brown ground colour.

Amongst the various kinds of injury to leafage sent me, or described to me, by Miss Sturge as going on amongst her Osiers to a very serious

extent, I cannot tell how much might be owing to this special kind, the “ zigzag ” caterpillar. I should think, however, that part of the great mischief reported to me on June 13th, might very likely indeed be caused by the larvæ of this *Notodonta ziczac* whilst still in the very young state which they would almost certainly be in early in this month.

Some of this mischief was caused beyond doubt by caterpillars of the *C. reclusa* moth, and the “ Cuckoo-spit ” insects, as mentioned in the preceding paper; but on turning to my reply to Miss Sturge’s letter, I find I mentioned, “ From the manner in which the skin of the leaf has been gnawed, I should think that very likely you had the ‘ Willow Beetle ’ present.” In the case of this beetle infestation the larvæ feed on the under side of the leafage, working right through to the upper films until it is so thin that it cracks, or may crack, and dry away. Although I was in communication with Miss Sturge until autumn or early winter, no observation was made of Willow Beetle being seen; but finding later on that *N. ziczac* was present, I turned to the account of it by Mr. Hellins (previously quoted), and there I find the following passage:—“ After the larva begins to feed, a greenish tinge comes over the body; at first the larva gnawed only one side of a Willow leaf, leaving the opposite skin and all the ribs untouched.”

With advance of growth, presumably, this habit is left off; so far as I saw, the leaves of Weeping Willow, which I used as food, were consumed from the edge. But in future instances of infestation it would be well worth while to investigate this matter fully.

The methods of prevention and remedy would be similar to those for destroying the *C. reclusa*, noticed at pp. 143—145.

SAWFLIES.—Willow Sawfly. *Nematus salicis*, L.

Amongst the various kinds of Willow infestations of which samples were sent, were those of several species of Sawflies, of which the following is, I believe, not very common, and possibly the local outbreak to such a serious extent may have been influenced by the peculiar weather conditions of the spring and early summer.

On July 6th, I was favoured with the following note of observation from Mr. J. Brooke, of Haughton Hall, Shifnal, Salop:—“ The caterpillars, of which I enclose a specimen, I found in such numbers on a row of Pollard Willows, at Sutton Maddock in this county (Salop), as to completely strip them of leaves. I presume it is the larva of some Sawfly, but I am not able to identify it, nor did I ever see it in such quantities before.”

The specimen sent agreed even to almost (if not quite) the minutest particulars with the description of the larva of the *Nematus salicis* given by Mr. Cameron, and the coloured figure after Brischke.* The peculiar colouring of the caterpillar makes it very noticeable; the head being black; the first three segments, and also the last of some tint of orange, and the intermediate segments bluish green. Along the body are seven rows of black points or spots, which are sometimes counted as nine where the two black spots on each segment, between the dorsal and first side row, are also counted as forming a row on each side. The spots, or points, are fewer on the orange segments, and over the tail is a large black spot. "The thoracic legs are marked with black, the claws being of the same colour." It may perhaps be of some service to remark in passing that "Sawfly" caterpillars are commonly distinguishable from caterpillars of butterflies and moths by the much greater number of their prolegs, or sucker-feet, so that altogether, counting claw-feet and sucker-feet, there are commonly from eighteen to twenty-two legs. In the genus *Nematus* the larvæ have twenty or eighteen legs; in the case of the *N. salicis* I am not perfectly sure of which number it is possessed, but I think it is twenty.

Where the larvæ are numerous, as occurs on the Continent, they are described by Kalténbach as feeding voraciously on the leafage of various kinds of Willows; and it is mentioned by Dr. Ritzema Bos that there are two to three broods in the year. The cocoon is formed in the ground, so that where attack has been troublesome, lightly disturbing the surface of the soil so as to skim off the top down to where the cocoons lie and destroying them in the infested earth, would much lessen coming attack.

As this *N. salicis* does not appear to be very common in this country, it has seemed worth while just to allude to its presence; but so far as I am aware it was only seriously destructive in the one locality named.

Other kinds of Sawfly attack were also present on Willow, of which specimens were forwarded to me, but which I have not entered on at length, as they were not of special importance. In practical work these infestations are generally observed in larval state, or are drawn attention to by the peculiar method of injury, or by the growths sometimes caused, as for instance, the green or rosy galls sometimes found in great numbers on Willow leaves.

The special kind of Sawfly causing each kind of attack is often not noticeable without much watching; amongst other reasons, because when the grubs are large enough, or the galls large enough, to be

* See 'Mon. of Brit. Phytophagous Hymenoptera,' by P. Cameron (Ray Society), Vol. II., pp. 163, 164; and Plate VII., fig. 9, in Vol. I.

noticeable, the Sawflies which laid the eggs may very likely have passed away. But I add a figure of the Gooseberry Sawfly, *Nematus ribesii*, magnified, belonging to the same sub-group as *N. salicis*, as an example of the general appearance of the imagos of this genus. The imago of the *N. salicis* is to some degree distinguishable by its large



NEMATUS RIBESII, magnified; length of body from a quarter to a third of an inch.

inflated yellow abdomen, and the nerves, blotch, and line below it (*stigma* and *costa*) on the front edge of fore wings being black; the wings are hyaline and yellowish; length of body half an inch or rather less. For full description see Mr. P. Cameron's work cited p. 148.

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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS,
DURING THE YEAR 1894,
WITH METHODS OF
PREVENTION AND REMEDY.

EIGHTEENTH REPORT.

BY

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PREFACE.

DURING the past season of 1894 nearly all our common kinds of crop and orchard insect pests were present, but no attacks were reported as being prevalent generally over the country to a serious extent, or (excepting in the case of the Antler Moth) over large districts.

Amongst the infestations regarding which enquiries were sent, there were a few of which the presence in this country had not previously been recorded; and a few also of kinds which, though well known, are very rarely injurious to farm or fruit crops; and, early in the season, there was (temporarily) a threatening of repetition of some of the preceding year's chief infestations, consequent on the unusual numbers which had survived from these through the winter.

In the following observations I have, as far as possible, not entered again on such of our common infestations as have been repeatedly noticed in my preceding Reports, excepting where there was some new information given, or (sometimes) needed.

Amongst these was the presence of Grain Aphis, differing a little in colouring from the common kind, on grass near Newcastle-on-Tyne; noticeable benefit to corn crops attacked by Hessian Fly from the occurrence of good growing weather; the attack of the so-called "Charlock Weevil" to Mustard being injurious to plants in much more advanced stage of growth than had previously been observed; and, with regard to Diamond-back Moth infestation on Turnips, we had further confirmation of the serviceableness of some of the very simple applications and methods of treatment previously recommended.

In regard to Wireworm, the Special Report of information contributed to myself by leading agriculturists of Great Britain and Ireland in 1882, and given at pp. 22—63 of my own Annual Report for that year, as well as officially in the Journal of the Royal Agricultural Society, appears to convey most of the information commonly needed; therefore I have only now added (p. 42) a few observations showing power of endurance of paraffin oil by Wireworms.

Millepedes, or False Wireworms, are again mentioned in the following pages, as practicable methods for their destruction as field pests are still very much needed.

The attacks *not* previously recorded as present are all of

importance. These are the small moth caterpillars at young Wheat (pp. 37—40); the discovery of the grubs of the Turnip Mud-beetle feeding in the uppermost part of the bulb, and within the base of the leafage (pp. 104—110); but probably the most important discovery of the year is that which we owe to the skilled researches of Prof. John Percival, of the South-Eastern Agricultural College, Wye, near Ashford, Kent, of the presence of two kinds of Eelworms at the roots of Hops (pp. 52—60), of which one kind, which is seriously destructive to various kinds of crops on the Continent, had not previously come under notice in this country, and neither had been previously observed at Hops.

The most widespread infestation of the past year was that of the Antler or Grass Moth (pp. 12—23), which extended over areas in seven or more Scottish counties, and has given opportunity of study of some at least of its parasitic destroyers, to which should be added one more (of which the observation was more recently contributed), that of the two-winged fly, the *Exorista lota*, of which specimens were bred by Mr. Service, and kindly identified for me by Mr. R. H. Meade, of Bradford.

The great point of attention, however, of the year has been Ox Warble; we (that is, those concerned) have been working on constantly, steadily, and with good results, and especial advance has been made in attention to the subject in Ireland. So long as the simple directions, which we have kept well before cattle-owners for the last seven years,* are followed, we do well. But I am bound, though with much regret, to lay before all concerned that there is great cause for being on the alert against advice claiming to be authoritative, yet in which well-proved, easily practicable, and almost costless treatment is left unnoticed, and inefficient application advised.

During the past season enquiries or observations regarding about or upwards of 140 distinct species of infestations have been sent to me, mainly regarding insect attacks, but also including several other kinds of injurious attacks, as of Eelworms, Red Spider, Millepedes, &c.

Of these I subjoin a list of the more important kinds, arranged, as this is merely intended for popular reference, alphabetically by their English names under the heading of their respective orders:—

Beetles (*Coleoptera*).

| | |
|---|--------------------------|
| Apple-blossom Weevil, <i>Anthonomus pomorum</i> | Apple-flower buds. |
| Asparagus Beetle, <i>Crioceris asparagi</i> | Asparagus. |
| Bean-seed Weevils, <i>Bruchus rufimanus</i> | Bean-seed. |
| Cabbage & Turnip-gall Weevils, <i>Ceutorhynchus sulcicollis</i> | Cabbage- & Turnip-roots. |
| Chafers, Cockchafer, <i>Melolontha vulgaris</i> | Leafage and Grass-roots. |
| „ Rose Chafer, <i>Phyllopertha horticola</i> | „ |
| Charlock Weevil, <i>Ceutorhynchus contractus</i> | Young Mustard plants. |
| Death-watch Beetles, <i>Anobium striatum</i> | Furniture and timber. |

* See Appendix, page lix.

| | |
|---|----------------------------|
| Elm-bark Beetles, <i>Scolytus destructor</i> | Elm-bark. |
| Flea Beetles, Turnip, <i>Phyllotreta</i> of various species . . | Turnip-leafage. |
| Ground Beetle, <i>Pterostichus madidus</i> | Strawberry fruit. |
| „ <i>Harpalus ruficornis</i> | „ |
| „ <i>Catathus cisteloides</i> | „ |
| Ladybird, Eyed, <i>Coccinella ocellata</i> | Fir; exceptionally on Hop. |
| „ Minute Black, <i>Scymnus minimus</i> | Red Spider. |
| Mustard Beetle, <i>Phædon betule</i> | Mustard. |
| Pea-leaf Weevil, <i>Sitones</i> of various species | Pea-leafage. |
| Raspberry Beetle, <i>Byturus tomentosus</i> | Raspberry. |
| Shot-borer, <i>Xyleborus dispar</i> | Growing wood. |
| Turnip Mud-beetle, <i>Helophorus rugosus</i> | Turnip-leaves and bulb. |
| Turnip-seed Weevil, <i>Ceutorhynchus assimilis</i> | Turnip-seed. |
| Weevil, Black Vine, <i>Otiorhynchus sulcatus</i> | Vines, &c. |
| „ Clay-coloured, <i>Otiorhynchus picipes</i> | Raspberry, &c. |
| Wireworms, <i>Elaters</i> of various species | Grass and crop roots. |

Butterflies and Moths (*Lepidoptera*).

| | |
|---|-------------------------|
| Alder Clearwing Moth, <i>Sesia sphegiformis</i> | Alder-stems. |
| Antler Moth, <i>Charæas graminis</i> | Grass. |
| Cabbage Small White Butterfly, <i>Pieris rapæ</i> | Cabbage-leaves. |
| Codlin Moth, <i>Carpocapsa pomonella</i> | Apples. |
| Currant Clearwing Moth, <i>Sesia tipuliformis</i> | Currant-stems. |
| Diamond-back Moth, <i>Plutella cruciferarum</i> | Turnip-leaves. |
| Goat Moth, <i>Cossus ligniperda</i> | Live timber borer. |
| Grain Moth, <i>Tinea granella</i> | Stored corn. |
| Lackey Moth, <i>Bombyx (Gastropacha) neustria</i> | Apple-leaves. |
| Lappet Moth, <i>Gastropacha quercifolia</i> | Apple-leaves. |
| Surface Caterpillars of <i>Agrotis segetum</i> and other species. | Turnip and Mangolds. |
| Tortoise-shell (Large) Butterfly, <i>Vanessa polychloros</i> . . | Cherry- and Elm-leaves. |
| Wheat Caterpillars, ? <i>Miana exopolita</i> | Young Wheat. |
| Winter Moth, <i>Cheimatobia brunata</i> | Tree-leafage. |

Two-winged Flies (*Diptera*).

| | |
|---|---------------------------------------|
| Cabbage-root Fly, <i>Anthomyia</i> of various species | Cabbage-roots. |
| Carrot Fly, <i>Psila rose</i> | Carrot-roots. |
| Celery-leaf Maggots, <i>Tephritis onopordinis</i> | Celery-leaves. |
| Daddy Longlegs, <i>Tipula oleracea</i> | Grass and crop roots. |
| Frit Fly, <i>Oscinis frit</i> | Young plants and ears of Oats. |
| Gout Fly, <i>Chlorops tenuipus</i> | Upper joint of Barley. |
| Hessian Fly, <i>Cecidomyia destructor</i> | Corn-stems. |
| Hop Strig Maggot, <i>Cecidomyia</i> ? sp. | Hop-cones. |
| Horse Warble, ? <i>Hypoderma Loiseti</i> | Horse-hide. |
| Mangold Maggot, <i>Anthomyia (Chortophila) beta</i> | Mangold-leaves. |
| Onion Fly, <i>Anthomyia ceparum</i> | Onion-bulbs. |
| Ox Gad Fly, <i>Tabanus bovinus</i> | Blood-sucker. |
| Ox Warble Fly, <i>Hypoderma bovis</i> | Cattle-hides. |
| Parasite Fly, <i>Exorista lota</i> | In larvæ of <i>Charæas graminis</i> . |
| „ <i>Tachina larvæ</i> | „ |
| Sheep's Nostril Fly, <i>Estrus ovis</i> | Nostrils of Sheep. |
| Turnip Winter Gnat, <i>Trichocera hiemalis</i> | In decayed Turnips. |
| „ Thaw Gnat, <i>Trichocera regelationis</i> | „ |
| Wheat-bulb Maggot, <i>Hylemyia coarctata</i> | In young Wheat. |

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

| | |
|--|--------------------------|
| Apple Sawfly, <i>Hoplocampa (Tenthredo) testudinea</i> | Apple-blossom and fruit. |
| Gooseberry Sawfly, <i>Nematus ribesii</i> | Leafage. |
| Pear Slugworms, <i>Tenthredo cerasi</i> | Pear-leafage. |
| Sirex gigas | In Fir timber. |
| Wasps and Hornets, <i>Vespidæ</i> of various species as vul- } <i>garis, rufa, germanica, cralro, &c.</i> } | In ground and tree |

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

| | |
|--|---------------------------------|
| American Blight, <i>Schizoneura lanigera</i> | Apple-bark. |
| Beech Aphis, <i>Phyllaphis fagi</i> | Under Beech-leaves. |
| Cherry Aphis, <i>Myzus cerasi</i> | Cherry-leaves and shoots. |
| Currant Green Fly, <i>Rhopalosiphum ribis</i> | Currant-leaves. |
| Currant and Gooseberry Scale, <i>Lecanium ribis</i> | Currant- and Gooseberry-shoots. |
| Currant White Woolly Scale, <i>Pulvinaria ribesiae</i> | Currant-shoots. |
| Grain Aphis, <i>Siphonophora granaria</i> | Corn and Grass. |
| Mealy Bug, <i>Coccus adonidum</i> | Vines, &c. |
| Snowy Fly, Cabbage, <i>Alegrodes prolella</i> | Cabbage-leaves. |

Of Thysanoptera, we had the Corn Thrips, known with us as the *Thrips (Limothrips) cerealium* of Haliday, and the "Black" Thrips, the *Thrips (Heliothrips) hæmorrhoidalis*, on Vine-leaves.

Of other serious plant infestations not of insect kind, we had the Stem, Beet, and Root-knot Eelworms, respectively the *Tylenchus devastatrix*, *Heterodera Schachtii*, and *H. radicicola*. Spring-tail, *Smynturus luteus*, on Turnip-leaves. Of *Acari*, Red Spider, *Tetranychus telarius*, on Hops; and *Bryobia pretiosa*, on Gooseberry; also Hay Mites, *Tyroglyphus longior*; and the Gall Mites, *Phytoptus ribis*, in Black Currant-buds; and *P. pyri* in Pear-shoots.

Very many other infestations were enquired about, of which the enumeration would be too tedious; but it may be just mentioned that this included various tropical attacks, as to Sugar Cane, Tea, Orange, &c., in various parts of the world; and notably an infestation of Chafer or Lamellicorne Beetles at grass-roots over the vast area of 40,000 acres of pasturage on land in the Argentine Territories of South America.*

These various matters I attended to, to the best of my power, and preserve the record of, with date, and name of sender of enquiries, in the daily entries in my letter-books; and where the subject is of importance (and in many other cases), my contributors' letters are also preserved.

In my work I am greatly indebted for assistance in difficult points of identification to the kind help of skilled colleagues, and amongst these, during the past year, I desire particularly to thank Mr. R. H. Meade, of Bradford, for help in identification of Diptera; Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, for assistance in the difficult study of Nematodes, or Eelworms; and to Prof. J. Jablonowski, of the entomological staff of the Government Entomological Station at Budapest, Austria-Hungary, I am much indebted for colleague-ship in economic entomological work and technical information regarding the plant pests known with us as Thrips. To these friends, and other friendly helpers amongst the economic and

* From specimens sent me, which were kindly identified for me by Mr. O. E. Janson, F.E.S., these proved to be of the *Diloboderus abderus*, and of the *Eucranium arachnoides* and *Megathopa violacea*, on which I have given a short paper, with figures, in the 'Entomologist' for August, 1894, pp. 229—232.

official entomologists both on the Continent of Europe and the U. S. A. and our Colonies, I am greatly indebted, not only for the assistance of their collegueship, but for the liberal supply of valuable publications, for all which I trust they will accept my hearty thanks.

To our own agricultural press, and to many of the more general journals, I am at a loss to express my thanks for their powerful assistance to the cause of prevention of insect injury, and their courteous encouragement to myself.

Of the illustrations to the present Report, the full-page Plate of *Tylenchus devastatrix* is given by his kind permission from figures by Dr. J. Ritzema Bos; of the forty wood engravings, those of the Golden Eye, Millepedes, Diamond-back Moth, and Winter Gnat, I am permitted the use of by Messrs. Blackie, of Glasgow; Corn Aphides (p. 24) are after figures by Mr. G. B. Buckton, F.R.S.; and the caterpillar of the Large Tortoise-shell Butterfly (p. 6) after figure by the late W. Buckler. The moths in the figures of Antler Moth (p. 12), and Currant Clearwing (p. 43), are from figures of which I am permitted the use by Messrs. Allen & Co., London. The other figures, where not acknowledged accompanying, have been drawn for this series of Reports.

For myself, I may say that I hope to continue to answer any enquiries on insect matters with which I may be entrusted to the very best of my power, whether from our farmers and fruit-growers, the editors of our agricultural papers (for whom it is always a pleasure to me to identify insects of which the names may not chance to be known to them), or others where such information as I could give might be of service.

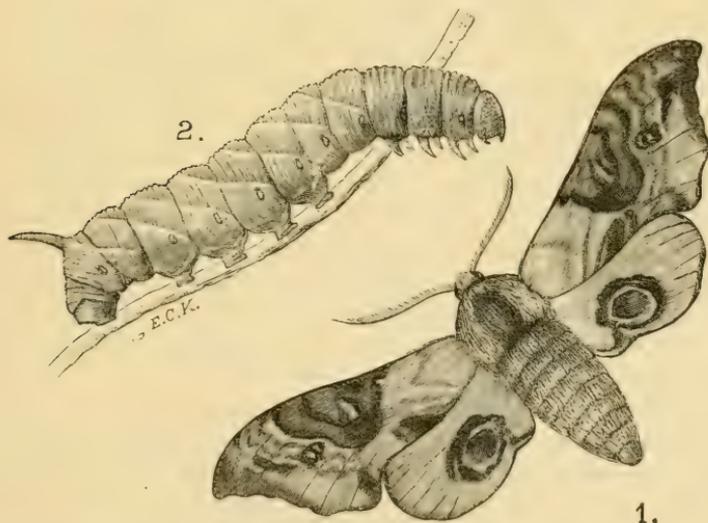
ELEANOR A. ORMEROD.

TORRINGTON HOUSE, ST. ALBANS,
February, 1895.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1894.

APPLE.

Eyed Hawk Moth. *Smerinthus ocellatus*, L.



SMERINTHUS OCELLATUS.—1, Eyed Hawk Moth; 2, caterpillar.

THE Eyed Hawk Moth is to be found at many places in England, and its very large and handsome pale-green caterpillars are recorded entomologically as being "very common in the autumn, feeding on Apple trees in gardens, and on Willow bushes in hedges." Complaints of the attack, however, are not often sent me, presumably because, though the caterpillars are of such a great size, reaching as much as

three inches in length when full-grown, their various tints of green so much resemble those of the Apple leafage, that they are not readily observable. Even in the case of specimens sent for examination amongst twigs of Apple leaves, I found it required a little care to be sure that some did not escape notice.

Fig. 2, at heading, is drawn from a full-grown specimen. The general colour of the caterpillars is what is known as apple-green, but varies in tint, being sometimes of a yellower, sometimes of a bluer colour; the skin rough or "shagreened," and dotted with white; on each side are seven white stripes slanting backwards at the top, each stripe (at least when the larva is nearly full-grown) having along its front edge a line of green of darker colour than the ground. The seventh stripe is longer than the others, and is continued up into the horn-like process at the tail. This horn is rough, pale or sky-blue in colour, and greenish or black towards the tip. The head (after the first moult) is somewhat triangular in front, with the point at the top; the three pairs of claw-feet are pinkish or brownish, the sucker-feet beneath the body, and the pair at the tail, green; but this caterpillar varies much in detail of colouring with the successive moults.* Those which I examined were almost or quite full-grown.

Last year (1894) I had only two notices of presence of this caterpillar besides what might be noticed casually in my own garden. The first observation was sent me on the 27th of August, by Mr. Thos. Harley, from St. John's Cottage, Bewdley, with the remark:—"I send herewith a caterpillar which I find stripping the leaves of Apple trees." . . . "Last year, in August, I found one specimen of it, apparently the only one, but this year I have found half a dozen, all in the course of the past two or three days. In each case Apple trees only were attacked." . . . "The caterpillar is very destructive; from its colour it is scarcely discernible, and attention is only drawn to it by seeing the young shoot, which it seems to prefer, entirely stripped of its leaves."

On the 18th of September, Mr. Andrew Howard, writing from Meldruth, Cambs, remarked:—"I am sending to you by this post a box containing three caterpillars; they are quite strange to me. I have found seven or eight each on a separate tree (Apple trees planted one or two years). They entirely denude the tree of all its leaves, but as they are few, and the leaves will soon naturally fall, I do not intend to poison them with London-purple, which I have no doubt would soon settle them."

Accompanying Mr. Howard's letter were two very good specimens of the Eyed Hawk Moth caterpillars, one specimen upwards of two and

* For description of the changes, see 'Larvæ of British Butterflies and Moths' (Ray Society), by the late W. Buckler, vol. ii. pp. 99—103.

a half inches in length, and the other more than two inches. These were very characteristic examples, and had arrived at the fourth moult, in which the tips of the lobes of the head above the face become shortened above, and lose the red tint (see description by W. Buckler previously referred to). The leafage of one of the Apple shoots, sent accompanying, had been eaten away right down to the footstalks; but whether this was entirely the work of the Hawk Moth caterpillars, or the other moth caterpillar accompanying had helped at the mischief, was uncertain.* This, however, was immaterial, the Hawk Moth caterpillars being known to be very destructive. The chrysalis is red-brown, and from this the moth comes out in the following summer. The size and shape of this is given at fig. 1, p. 1. It varies from about two and a quarter to three inches in the spread of the fore wings, which are rosy brown or ash, with olive-brown markings; the hinder wings are rosy, shading to brown or grey at the margin, each wing bearing a large eye-like spot, grey in the centre, with a blue ring outside, and this again surrounded by a black ring. From this eye-like spot the "Eyed" Hawk Moth takes its name.

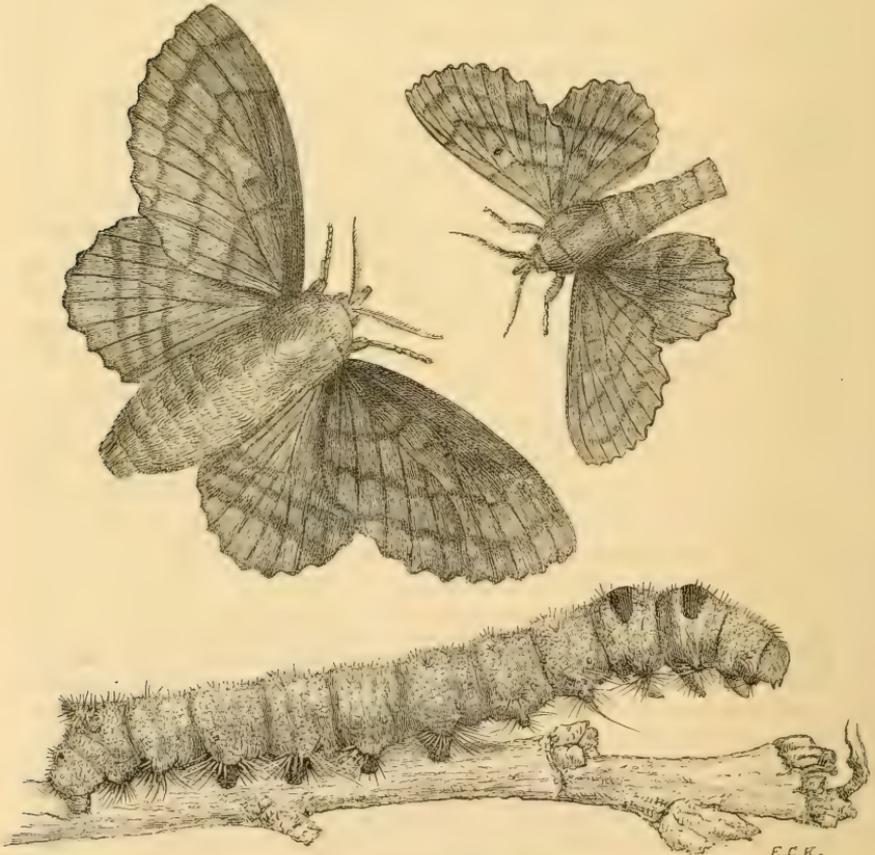
The moth appears about midsummer, earlier or later as the case may be; but the caterpillars are rarely sent me until they are full-grown, or nearly so, and attention is drawn to their presence by the mischief they are causing amongst the leafage.

When this is observable, the best remedy would certainly be to pick off all the caterpillars in reach, and (to remove those not in reach of mere hand-picking) a deal might probably be done by knocking them off individually with a long light pole. Jarring the boughs, or spraying, would be eminently objectionable treatment to trees with maturing crop; but with great grubs like these, even if they could not be loosened from their hold by the end of a pole, many might be cleared by having a spud fixed at the end of it,—thus a sharp blow could be given to the grub on an infested leaf, or by running the edge of the spud upward beneath a grub on a shoot it could be scraped off. Or again, with the help of a long-handled pair of small nippers any leaves on which these great caterpillars were seen at work could easily be cut off so as to fall with the grub.

* This caterpillar was a larva of the *Notodonta (Lophopteryx) camelina*, L., popularly the "Coxcomb Prominent" Moth. This is a pretty caterpillar, which is said to vary much in colour. The specimen sent was of the variety which is whitish green along the back. Along the side is a pale spiracular line; the spiracles are black, with a pink spot behind each; and above the tail are two tubercles tipped with pink. The length when full-grown is about an inch and a third, and the caterpillar feeds on many kinds of leafage. The autumn caterpillars have been recorded as spinning up in a cocoon of fine silk mixed with earth during October. Descriptions and figures of moth and larvæ will be found in Newman's 'British Moths,' and others of our publications on British Lepidoptera.

But with these, as with other occasional infestations of large and handsome caterpillars, sometimes of rare species, and usually not very numerous, it would often be the best way towards getting rid of them to let some neighbouring collector of entomological specimens know of their presence. In some instances their rarity would make permission to clear them an acceptable boon to the scientific entomologist; in others they would be a welcome addition to the stock of the professional naturalist; and during the last few years, when such rare attacks as those of the Alder Clearwing Moth, or the great Lappet Moth, have required extermination for obvious economic reasons, it has been so urgently mentioned to me by entomological friends that they regretted not to have been told of the chance of securing specimens, that I just allude to their wishes as often helping to a serviceable remedial measure.

Lappet Moth. *Gastropacha Quercifolia*, Linn.



GASTROPACHA QUERCIFOLIA.—Lappet Moths, male and female, and caterpillar, also Apple twig with leaves eaten away; all from life.

Early in the month of May in 1893, information was sent me from Hereford, by Messrs. Cranston, of the enormous caterpillars of the Lappet Moth (one of which is figured life size at p. 4) having been found present on some of the Apple trees on their grounds at King's Acre, and though not found in any considerable quantity, yet where they were present every leaf had been devoured. Some specimens of the attacked branches were sent accompanying (one of which is figured at p. 4) to show the manner in which a complete clearance of the leaves down to the very stumps of the footstalks had been effected.

The grubs being so large, it was hoped that the attention devoted to the attack might have prevented any recurrence of the trouble; this, however, has not proved to be the case, and on May 10th of the past season I was again favoured by a communication on the subject from Mr. John Cranston as follows:—" . . . I am sending you by this post some of the Lappet Moth caterpillars; the grubs vary much in size, but there are none so large as those I sent you last year, and which you have illustrated in your publication. We find the caterpillars feeding upon the young maiden Apple trees, and very few upon the older trees. As they are found only in small quantities here and there, the simplest and least expensive mode of destroying them is by hand-picking them. I have no doubt that spraying the trees with Paris-green would cause them to fall off, but it is doubtful if this would kill them."—(J. C.)

Accompanying the letter, more than a dozen of the "Lappet" caterpillars were sent, ranging from an inch and a quarter to two inches and a quarter in length, but mostly of the larger size, and of a greyish ground colour. Two or three were of the smaller size, and these of a rich brown ground colour. These caterpillars, when full-grown, are as much as four or even five inches in length (the specimen sent me last year was more than four inches long), and are of a variable tint, sometimes of a grey, or sometimes of a brownish, ground colour, and the markings also variable, sometimes occurring as a row of somewhat V-shaped marks, sometimes almost wholly absent. But amongst the characteristic markings are two deep blue or purple, lustrous, velvety, transverse bands, so shiny that, in German, they are known as "the mirrors" (Spiegel). These are placed across the back, on the segments next the head, and are very noticeable when the caterpillar is moving, but scarcely at all when it is at rest. Another very remarkable characteristic of the caterpillar is that along each side, and just above the feet, is a row of fleshy warts or appendages with long grey hairs. To these the name of "lappets" has been given, whence the name of Lappet Moth. These "lappets" show clearly on the segments not furnished with feet, or sucker-feet; but they are so often not clearly represented (especially above the sucker-

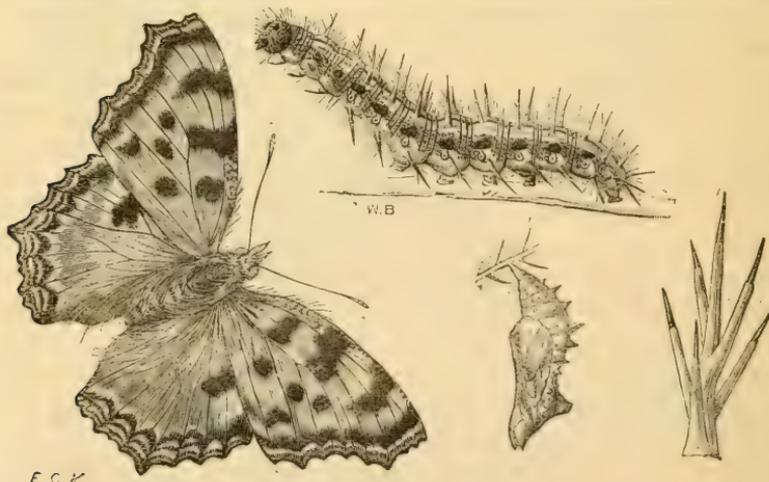
feet) that much care has been taken to give them distinctly in the figure at p. 4; and the two transverse, velvety patches are also clearly shown.

When full-grown, which may be early in the summer, the caterpillars turn to chrysalis condition in dark coloured oval cocoons, which are spun apparently in any convenient shelter, as possibly under eaves, &c., but also in crevices of bark, or on the lower twigs of the plant on which the caterpillar fed, or amongst the grass near to the ground. From these cocoons the moths appear, according to circumstances, from May to August. The figure at p. 4, from life, shows shape, size and markings of a male and female Lappet Moth. The colours are of a rich brown with darker markings.

In my 17th Report, I have given a detailed account of this infestation, with suggestions as to prevention and remedy, but it has seemed desirable just to mention its reappearance, as this attack is very rarely observed with us as an orchard pest.

CHERRY.

Large Tortoise-shell Butterfly. *Vanessa polychloros*, Linn.



VANESSA POLYCHLOROS.—Large Tortoise-shell Butterfly; caterpillar and chrysalis, nat. size; branched spine from caterpillar, magnified.

The Great Tortoise-shell Butterfly was recorded some fifty years ago as being occasionally very abundant, but very uncertain in its appearance, and in 1857 it was noted in Stainton's 'Manual' as

occurring in the south, but not generally common, and it is a coincidence perhaps worth notice that whilst the only locality given where it was then "abundant" was Lyndhurst, in Hampshire, in the centre of the New Forest, that in the past season the notes of injury caused by this rare infestation were from Lymington, on the southern border of the New Forest, not many miles from the above locality of its former abundance.

The *Vanessa polychloros*, or Large Tortoise-shell Butterfly, is a remarkably handsome insect about two and a half inches across in the spread of the fore wings, which are marked (as figured at p. 6) with black blotches or spots on a tawny or orange-red ground. It will be seen that there are two large squarish blotches, and a smaller one, along the fore edge of the wing, four about the size of the smaller costal blotch disposed in the centre, and towards the hinder part of the wing; the outer margin is dark, with an irregular pale line in it. The hind wings are also tawny or orange-red, but with only one black blotch, and the dark border is varied by blue crescent-shaped markings, as well as by pale colouring forming a kind of irregular line outside them. The under sides of the wings are marked transversely with wavy lines, the basal half being thus of a mottled and of a brownish tint, succeeded by a broad greyish band, and this by a dark border at the edge of the wing, with a wavy blue band, or line of blue crescents, at the inner margin; in the centre of the hind wings is a little white spot. Along rather more than a third of the basal part of the *costa* (fore edge) of the fore wings is a row of long strong bristles, which were considered by the Dutch entomologist, Mons. P. C. T. Snellen, to be the structural characteristic by which the *V. polychloros*, or Great Tortoise-shell, might be distinguished from the *V. urtica*, the Small Tortoise-shell Butterfly, which sometimes is exceedingly similar in colouring to the larger and nearly allied species.*

In this country, the caterpillars are given by Prof. Westwood and Mr. H. T. Stainton as especially feeding on Elm; and the caterpillars from which the late W. Buckler's descriptions were taken,† were received by him on Elm twigs; and in Edw. Newman's 'British Butterflies,' the English food trees are given by the author as the Aspen, the White Beam, Sallow, Osiers, more commonly the different species or varieties of Elm; and in gardens it is also found on Cherry and Pear trees. Mr. Newman also observes:—"The wild and cultivated Cherry (*Prunus cerasus*), the Cerisier and Griothier of the French, seems the tree chiefly selected in France, and whole rows of these

* See 'Entomologist's Monthly Magazine,' No. for September, 1883, p. 82.

† See 'British Butterflies and Moths,' by the late W. Buckler (Ray Society), vol. i, p. 54.

trees may occasionally be seen in July entirely stripped of their leaves by the caterpillars of this species."*

In the observations sent me from near Lymington last year, the caterpillars were noticed as injurious to the Elms, but the progress of the attack was especially watched on a Cherry tree; and in the German observations of Dr. Taschenberg and Kaltenbach they are mentioned as feeding on leafage of Cherry, Pear, Apple and Quince, besides Elm, Willow, &c.

The first observation of attack was sent me on the 19th of June, from Ossemsley Manor Farm, Lymington, Hants, by Mr. D. D. Gibb, who mentioned that on the preceding day he had observed that a Cherry tree on his lawn was being stripped of its leaves in a very rapid manner, and on close inspection he found a few beetles, which he believed to be Cockchafer (they were so, Ed.), but on several branches which were almost entirely stripped of leaves, some large caterpillars (of which specimens were also sent) turned out to be the destroyers; and, as Mr. Gibb remarked, "Aided by a high wind, with heavy showers of rain, and hand-picking from all the branches within reach, I trust to make short work of this pest. Otherwise the tree would evidently have been speedily stripped of all the leaves."

On June 25th, Mr. Gibb wrote further, with date of when the commencement of the mischief was noticed:—"On the 16th of June I first observed something amiss with a Cherry tree on my lawn; when examined on the 18th, the caterpillars which I sent you were found to be causing the mischief. I am not surprised to find they are those of a *Vanessa* butterfly,—several 'Large Tortoise-shell' Butterflies were seen in the spring, and one or two were brought in by my children, but their lives were spared.

"I now send herewith tips of branches where first observed, and showing the mischief caused. You will observe on the tip of one branch a cellular formation of a honey-comb nature. Can this be where the eggs were deposited and hatched?" (This was so, see description following, Ed.). "The young caterpillars certainly seemed to come from near this spot. By hand-picking the largest caterpillars (about two inches in length) were picked off and destroyed, others shaken and brushed off, while severe storms of wind and rain, with a low temperature about this time, destroyed the remainder. You will see adhering to the twig the remains of a great number of small caterpillars, which were destroyed by the storms before they had spread

* See 'British Butterflies,' by the late Edw. Newman, p. 55. In the same paper on the *V. polychloros* will be found a special report of a good deal of interest of English localities from which observations of its presence, and for the most part the small amount of insects seen, were sent to Mr. Newman.

over the tree to any distance; the larger ones either dropping or descending to lower branches by their gossamer threads.

“So far as I can see, the tree is now entirely cleared of the pest, and I send two more caterpillars which I picked some days ago, when I sent the others to you. These seem rather sleepy, but whether this dormant state be the natural transition, or brought about by confinement, I cannot say, at any rate they have lost their appetites.”—(D. D. G.)

The above sketch agrees very correctly with the recorded life-history of the Great Tortoise-shell Butterfly as given by various writers. The eggs are fastened or gummed in patches, often of from one to two hundred eggs on twigs of their food trees. The caterpillars, which hatch during spring from these eggs, live till their last moult in companies, and spin a web-covering for their common use. Their first food consists of the buds and young leaves; and by day they go out to feed, and in the evening return to their web. Their headquarters are noticeable by the condition of the twigs, which are nearly or quite stripped of leaves, and also by the dirt which, falling down, accumulates in a patch beneath the tree. The caterpillars are at first blackish grey, and strongly haired, and presently moult to an ochreous brown colour, mixed with black, and beset with numerous branched spines of a yellow or ochre-brown colour, each spine tipped with black. When full-fed, they are about two inches in length, and they then disperse, and suspend themselves by the tail in any convenient place for their change to the chrysalis state, from which the butterfly may be expected to appear in two or three weeks.*

From the specimens sent me by Mr. D. D. Gibb on the 26th of June, I was able to make some notes of the precise nature of the injury which was in progress. Two shoots from the infested Cherry tree were sent me, these, respectively, of about five inches, and seven and a half inches in length, with the leaves in most instances eaten away down to the central rib. Of seventeen or more leaves on the longer twig, there were only four with a fair supply of green remaining. Most of the others were little more than the central rib, now drying up and curled.

Towards the end of the longest twig amongst the stripped and curled mid-ribs were many cast caterpillar-skins with some web, the collection giving a good example of the habit recorded of this kind of caterpillar living in companies in a common web until near full growth. The cast skins showed successive moults of the larvæ; and

* For more detailed information, from which the above abstract is chiefly taken, see ‘Praktische Insektenkunde,’ by Dr. E. L. Taschenberg, pt. iii. p. 2; and also ‘Die Pflanzenfeinde (Insekten),’ by J. H. Kaltenbach, p. 183.

I found a difference in the colour with advance of age. The small cast skins were black or blackish, and most of these had the branched spines of a black tint; but in some cases the spine was tawny, or of an ochre colour tipped with black, as in the adult larva. In all the specimens which I examined, the heads were set with short, black, blunt points.

On the shorter twig there was a stripe or patch an inch in length, by about a quarter of an inch in breadth, of empty egg-shells, occupying about half the circumference of the twig. These eggs in their present state were very pretty objects. The contents being hatched out, the egg-shells were a mere whitish film, globular below, open above, so as much to resemble the shape of a common gold-fish bowl, and with about six ribs, of which the upper ends were well defined, running some way from the open top down the sides of the miniature bowl. These ribs were obviously the remains of what, whilst the egg was unhatched, would have been the star-shaped marking on the top noticed by Dr. Taschenberg (see previous reference). The eggs were firmly glued to the twig in about eleven longitudinal rows, the greatest number in one row being about thirty-three eggs.

The caterpillars, which I received alive from Mr. Gibb, were quite characteristic, and agreed almost to the minutest particular with Mr. Buckler's detailed description.* Speaking generally, they were of a black ground colour, but sprinkled with ochrey freckles along the back, so as to form two longitudinal stripes separated by a black line down the middle of the back; on the sides the tints are greyer. A "puffed ridge" of ochrey brown along the region of the black ochrey brown ringed spiracles. Lower part of the sides darker below; abdomen black below. Head black, studded with black points, and the claw-legs black; with the exception of the second segment, all the others are spiny, the third and fourth segments have four spines each, the fifth to the twelfth, inclusive, seven spines each, all branched (see fig., p. 6); the spines are yellowish, or ochrey brown, tipped with black.

Some of the caterpillars sent me turned to chrysalids on the journey, and another suspended itself by the tail, and went through the transformation, and at first the tints were very beautiful. The figure (p. 6) shows the angular shape with the centre of the thorax raised to a kind of obtuse point; also the notched ridge running along the centre of the back; on each side of the back, excepting near the thorax, was a row of tubercles, yellow at the extremity, and ringed with black. At the thoracic end of this row of tubercles, they are replaced by three spots on each side, which at first are very conspicuous

* See 'Larvæ of British Butterflies and Moths' (Ray Society), by the late W. Buckler, vol. i. p. 54.

from their white mother-of-pearl-like lustre, contrasting with the reddish surrounding colouring. These six bright spots (three on each side of the chrysalis) gradually changed in tint, until on the 29th of June they were altering to a golden, and thence to a reddish tint. In the first colouring, the abdomen was mainly of an ochrey tint, grizzled with black above; the thorax much redder, as also the elevations above the wings.

My own specimens of chrysalids being probably injured during transmission, or in larval stage, did not develop; but on the 28th of July, Mr. Gibb forwarded me a perfect specimen, developed from his own chrysalids of this *Vanessa polychloros*, or Great Tortoise-shell Butterfly, about two and a half inches in expanse of the wings.

Thus from Mr. Gibb's specimens and observations during the spring and summer of 1894, we have a complete account of the attack at Ossemsley Manor Farm, near Lymington,—this ranging through the various successive stages of observation of the butterflies early in the year; the presence of eggs on twigs; the webbed head-quarters of the caterpillars containing cast coats of the successive moults; the observation of the handsome striped caterpillar, with their branched spines as seen at full growth, together with observation of the devastation which they had been making to leafage; the change to chrysalis state going on, in some cases, on or about the 25th of June; and to complete and prove the observation as specified of the *Vanessa polychloros*, the development of the butterfly. Also, on the 30th of June, Mr. Gibb mentioned that he heard that the attacks of the Tortoise-shell Butterfly caterpillars had been very great this season on Elm and other trees, but were then past.

PREVENTION AND REMEDIES.—This attack occurs so very seldom to any seriously hurtful extent that remedial or preventive measures are rarely called for.

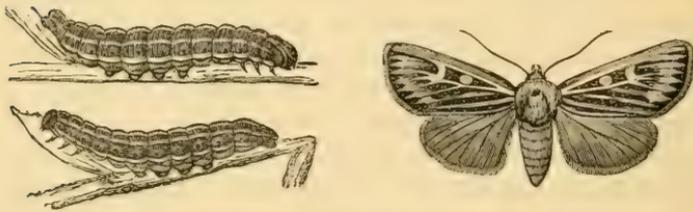
In cases (like that of the 1894 infestation) where the large butterflies were observed in the spring, it certainly would be desirable, so far as the safety of the leafage of fruit-trees and of some kinds of timber-trees was concerned, to kill all that could be captured. Probably, as this species is rare as well as beautiful, a hint given to any neighbouring entomologist would secure very efficient help in this matter.

If patches of eggs are noticeable, these should be cut off, and a good watch kept for the webby or spun nest which makes a head-quarters for the caterpillars in their early stages. The gnawed leafage and the fallen dirt would be a guide to the whereabouts of these. On timber-trees it would be hard to get at these nests, but on Cherry or other orchard trees something might be done by sending a boy up the

tree to nip these off when the caterpillars were found to be within, or strong jarring of the branches to make them fall, and then destroying the larvæ, would do good. Spraying with Paris-green would be an obviously useful treatment, and hand-picking still more so, where the great spiny caterpillars were in reach, as thus, when they were full-grown and seeking convenient place for turning to chrysalis-state, much might be done towards preventing recurrence of attack; but generally speaking the large and beautiful insects are so scarce that they might be left uninjured with little fear of consequences.

CORN AND GRASS.

“Antler,” or “Grass” Moth. *Charæas graminis*, Stephens;
Cerapteryx graminis, Curtis; and parasites of caterpillars.



CHARÆAS GRAMINIS.—Antler Moth and caterpillars.

One of the most remarkable insect appearances of the past year has been the widespread outbreak of vast numbers of the caterpillars of the Antler or Grass Moth (well described locally as the “hill-grub”) in the S.W. of Scotland; these attacks, as will be seen by the following observations, and also as specially reported by Mr. Robert Service, of Maxwelltown, Dumfries, “being more or less general over the hill country of Kirkcudbrightshire, and over the adjacent sheep-farms in Ayrshire, the Dumfriesshire hills, and the contiguous sheep-farm districts in Lanarkshire, Peebles, Selkirk, and Roxburgh. Seven counties were affected to my knowledge, and there may be more.”—(R. S.).

So far as the presence of the moth is concerned, this species has been recorded as widely distributed in England. It has been noticed as occurring at many places from various south-coast localities northwards, and also over the Scotch border, and in some of these places as being commonly found.* In Ireland the species is recorded as being

* See Stainton's ‘Manual of British Butterflies and Moths,’ vol. i. p. 204.

“universally common.”* But though the presence of the species is thus widespread, the remarkable point about it is the enormous numbers in which for no (apparently) known reason the infestation appears from time to time, especially in mountainous districts, or on upland pastures; so that the vast numbers of caterpillars appearing suddenly after their winter rest, and attacking everything suitable for their food over an area of several miles, is not only a serious scourge, but an exceeding astonishment popularly.

Numbers of these attacks, both on the Continent of Europe and in this country, are on record, from the time of Linnæus onward; but previously to this great outbreak of 1894 only two special appearances have come under my own notice. These were the attack of the caterpillars in June of 1884, extending over an area of about ten miles of Glamorganshire, lying west of the Rhonda Valley; and that of the summer of 1885, in Selkirkshire, when the caterpillars did much mischief on the hill-pastures of Ettrick and Yarrow. The Scottish attack of the past season extended over a far greater area of ground than the two above mentioned.

Generally speaking, the sudden and unaccountable (or at least unaccounted for) appearance of these devastating hordes, and presently their disappearance without notable recurrence of the widespread mischief on the same area in the following season, have been remarkable features of the attacks. But in that of the past season it will be seen from the observations that presence of the Antler Moths had been remarked in most unusual numbers—“extraordinary swarms”—over a part at least of the subsequently attacked district, and also, towards the end of the feeding-time of the caterpillars, various kinds of internal diseases or parasitic attacks, as of “flacherie,” threadworms, dipterous maggots, &c., were found present; and of the caterpillars kept in large numbers under observation many did not turn to chrysalids, and of such as did many did not produce moths,

The Antler Moth is of the size figured on p. 12, and takes its name from the pale, somewhat antler-like, markings on the brown colour of the fore wings; the hinder wings are of a brown or greyish brown. They appear in July or the latter part of the summer, or in the autumn, and each moth lays a large number of eggs; these, it is stated, are as many as two hundred, and are laid in little heaps in the ground, or at the base of the grass leaves and stems, on which the caterpillars feed. These eggs soon hatch, and the regular course † of

* “Catalogue of the Lepidoptera of Ireland,” by W. F. de Vismes Kane, ‘Entomologist,’ Sept. 1894, p. 264.

† In Kollar’s *Insects* the larva is mentioned as *in existence in autumn*, and hibernating in winter. Dr. Taschenberg, in his ‘*Praktische Insektenkunde*,’ notes that *before the caterpillars fall into their winter sleep they change their skins*

life is for the caterpillars to feed for awhile on the soft parts of the grass-shoots, to hybernate during the cold season, and with the following spring to wake up and again feed, carrying devastation before them, not only by the quantity of the softer parts of the grasses consumed, but by the destruction of what, though not eaten, is killed by being severed through.

Their habit, however, of feeding at the lowest part of the haulms or leaves does not in any way militate against their appearance above ground, at times in such myriads as to cause the utmost local astonishment or alarm to those not acquainted with the nature of the attack, this gregarious migration, whether to undestroyed pasturage or for any other cause, being one of the habits which causes the destruction of many of the larvæ, and also helps us to bring remedial measures to bear. In some of the earliest observations on them, about eighty

twice. Dr. Ritzema Bos also mentions, in his 'Tierische schadlinge und nutzlinge,' that the moths fly in July and August, that they lay as many as 200 eggs, and in about three weeks the caterpillars hatch; and in his recently published report on Plant Diseases and Injuries in the Netherlands in 1892—93, he mentions, in his observations on *Charæas graminis*, the fact of the caterpillars *wintering in larval state* being well known.

To the above notes, from entomologists of the highest standing, may be added the important observation by the well-practised Scottish naturalist, Mr. Robert Service, of Dumfries (see the 'Entomologist' for October, 1894, No. 377, p. 279), where, in his paper on *Charæas graminis* in Southern Scotland, he mentions that in a lot of eight Snow Buntings shot some years ago on Crawfordmuir, he found an average of eight or nine undigested skins of *Charæas graminis* in each of their stomachs.

We have thus a complete chain of evidence of the winter existence of the caterpillar traced onward, from appearance of the moths to quantity of eggs laid; time elapsing before hatching; number of moults before the caterpillars fall into their winter torpor; and also observation of their being found in January in the crops of insectivorous birds who had searched them out of their winter shelters.

I have specially drawn attention to this, as it is important to be rightly acquainted with the early history of the grubs, and what would apparently be a great misconception might arise from unconsidered reading of the notes by the late W. Buckler, given in his 'Larvæ of British Butterflies and Moths' (Ray Soc.), vol. iv. p. 67), and reprinted from his observations given in Ent. Mo. Mag. for February, 1869. Here Mr. Buckler mentions larvæ of *Charæas graminis*, *Helio-phobus popularis*, and *Luperina cespitis*, which he deals with together, as having great similarity, hatching "some time in spring, the exact date varying according to the character of the season." But taking the whole of the passage, it certainly appears to me that this statement may be supposed to refer to the history of the larvæ which he is describing from eggs sent him up to hatching-time, for he mentions the changes of colour in the egg before hatching out of the larvæ; and this must have been in *artificial circumstances*, as he mentions the eggs being sent him, and that he reared each species twice over to make sure of the distinctive markings. This is a very important point for consideration, and can hardly in any way be considered to militate against the correctness of the long-recorded observations in natural circumstances.

years ago, this habit was noticed, and in the great Glamorganshire attack of 1884 it was observed, "The mountain brook running from the Fforch Mountains was thick with the myriads of these caterpillars which had been drowned by falling into it during their march across the side of the mountains." The Ystrad side of the Bwleh-y-Clawdd Mountains above Cwm Park were brown, as the result of recent fires ignited with a view to destroy the pests. Near the summit the insects were observed, which moved down the mountain path from the burnt herbage with extraordinary rapidity.*

The caterpillars, when full-grown, are about an inch or rather more long, with brown head, and the body of a deep bronzy colour, exceedingly shiny on the back and on the upper part of the sides. The bronzy colour is divided lengthwise by three pale lines (see fig., p. 12), the back and side stripes meeting, or almost meeting, above the tail, and another narrower pale stripe or line runs lower down along each side.† During the summer the caterpillars turn in the ground to reddish or dark brown chrysalids, from which the moths presently come out, as previously mentioned; and it seems worth while to draw attention to the important fact that in some instances at least observation of the autumn appearance of the moth in unusual numbers might save us from the hordes of caterpillars of the following year finding us quite unprepared.

The first note of appearance of the Antler Moth caterpillars was sent me on June 22nd, from Milsington, Hawick, Roxburghshire, by Mr. Charles Scott, with the observation, "I herewith send for your inspection specimen of caterpillars which are making considerable havoc to the grasses on the hill-pastures in the western part of Roxburghshire; also the adjoining counties of Dumfries and Selkirk." The enclosure proved to be without doubt the larvæ of *Charæa graminis*, or "Antler" or "Grass" Moth; and a few days later, on June 28th, Mr. Scott further added that, after receipt of my reply, he had been looking more particularly at the caterpillars, and found some still quite young ones.

At the beginning of July I received information from Prof. Wallace (Professor of Agriculture in the University of Edinburgh) of the appearance in immense numbers of grubs in the highlands of the South of Scotland, more especially in the districts where the Voles did so much mischief not long ago, with the remark, "They are said to be worse than the Voles in some places." The consignment of

* 'Eighth Report on Injurious Insects,' by E. A. Ormerod, p. 18.

† For full description and details of distinction in markings between the larvæ of the *Charæa graminis* and those of two other very similarly coloured grass-feeding moth-caterpillars, see 'Larvæ of British Butterflies and Moths,' by the late W. Buckler (Ray Soc.), vol. iv. p. 69.

grubs sent accompanying showed them to be without doubt those of the Antler Moth.

In a letter to the 'Scottish Farmer,' Glasgow, written on July 4th, Prof. Wallace begins with the following remark, which is of interest geographically, as showing by the altitude that in this case certainly the attack might very correctly be described as affecting the "uplands":—"The Dumfriesshire Antiquarian Society had an excursion to Leadhills and the neighbourhood last Saturday, and amongst the trophies collected by the enthusiastic naturalists were a number of grubs of the Antler Moth, or Grass Moth, the *Charaas graminis*, Linn." On turning to Keith Johnston's 'General Gazetteer,' I find the following information:—"Leadhills, a mining village, and the highest in Scotland; county of and 18 miles south of Lanark, parish of Crawford, in a bleak district. Elevation, 1323 ft. above the sea. Mean temp. of year, 44.1°; winter, 32.1°; summer, 55.7° Fahr."*

The next communication was sent me from the more southerly locality of Tanlawhill, Langholm, in the south-east of Dumfriesshire, on July 2nd, by Mr. W. Gray; and this, together with the other short letters with which I was favoured by Mr. Gray will be found to be of much interest, in opening up the subject of parasitic infestation of various kinds being present to such a degree in the Antler Moth caterpillars as in all reasonable probability greatly to lessen amount of recurrence of this (the Antler Moth) attack.

From specimens forwarded in illustration of Mr. Gray's notes, we have observation of presence of a great deal of Nematoid, or Thread-worm, internal infestation. This, so far as shown by specimens sent of a species of *Mermis*; also presence of the severely infectious disease well known in Silkworm caterpillars as "flacherie," and (in the chrysalids) of bacteria, not yet identified; also, partly from Mr. Gray's specimens and partly from another source, we find the presence of maggots of the parasitic Tachinid flies. Other kinds of disease or parasitic infestation were present, which I notice, together with the above, further on in such detail as we have, under the heading "parasites"; but I first give Mr. Gray's communication, beginning on July 2nd, as follows:—

"I send you by same post as this some grubs which are doing great damage to grass in this district. On cutting them open I found three or four Hair-worms in them, and in two cases maggots." . . . "Out of a hundred grubs I had, I only got three chrysalids." On the 13th of July Mr. Gray sent me some more specimens, with the observation, "I have only got a few of the grubs, which I send you, also two maggots. I am sorry that I did not get your address sooner, as the shepherds say that they" (the caterpillars of the *C. graminis*) "seemed

* In the above quotation I have given words signified by contractions or single letters in the original at length for the sake of clearness.

all, when they first came, to have these hairworms within them; now there is only an odd one."

On the 16th of July Mr. Gray forwarded me more specimens of these Hair- or Thread-worms, which proved to be Nematoid worms of the genus *Mermis*, with the remark, "I send you some more caterpillars, also two of the Hairworms and one maggot"; and on the 12th of August Mr. Gray wrote further, still noticing the perishing of the chrysalids, and also presence of a disease which turned the caterpillars black, hard, and brittle. "I am sorry to say that the chrysalids I had, which I was watching, have all been spoilt. I have been wondering if the caterpillars and the Voles were in any way connected, as in 1891 and 1892 the Voles were very bad in this district, and sometimes these pests lead up one to another." . . . "Some of the caterpillars I found were the full length, and black and quite hard, and on breaking them I found them full of a reddish liquid." . . .

PARASITES.—The very long filiform worms, of which specimens were sent me by Mr. Gray, and which I also found alive in the Antler Moth caterpillars, proved to be Nematoid, or "Threadworms," of the genus *Mermis*. They were transparent and whitish, and, unless highly magnified, appeared only like a long white thread, but with great power of contorting themselves into an elaborate knot. The longest Threadworm which I managed to extract (so far as I could ascertain unbroken) was about eight inches in length, and from the same caterpillar I extracted a piece of Threadworm six and a quarter inches, and another about four inches long. As I could not trust to my own identification of Nematode worms, I forwarded several specimens to Dr. J. Ritzema Bos, Professor at the Royal Agricultural College, Wageningen, Netherlands, who was good enough to inform me that the Threadworms were certainly of the genus *Mermis*, and apparently *Mermis albicans*, v. Sieb., but this (*i.e.*, the species) he would not state positively, the part v. of the 'Zeitschrift für wissenschaftliche Zoologie,' in which this species is described, not being then at hand.

These *Mermis* live in the body-cavity of insects, and escape into the damp earth, where they come to sexual maturity and pair;* and in this same paragraph (see reference below) it is stated that v. Siebold established by experiment the fact of the migration of the embryos of the *Mermis albicans*, v. Sieb., into the caterpillars of the small moth, the *Tinea evonymella*, a small yellowish-grey caterpillar, with black spots, which lives on the Spindle-tree, which is of interest, as giving a precise record of their presence in one kind of lepidopterous larva.

"FLACHERIE."—Of the few *Charæas graminis* caterpillars which I was able to forward to Dr. Ritzema Bos, he further remarked, "One was attacked by 'flacherie'—'flaccidezza'—a disease which is also

* See 'Text-book of Zoology,' Clans & Sedgwick, vol. i., 2nd Edition, p. 356.

known to attack *Bombyx mori* and *Liparis (Ocneria) monacha*." In reply to my enquiries as to the characteristics of this disease, which I had never had the opportunity of studying, Dr. Ritzema Bos was good enough to give me the following introductory explanation:—"The phenomena of the 'flacherie' are—1st, the larvæ have no more appetite; 2nd, they do not eat more; 3rd, they become weak ('schlaff' in German), and when they walk on a leaf or a branch they attach themselves with one or two pairs of feet; and so the weak body hangs. Soon it shrivels, and only in the lowest part of the hanging body a brown liquid is found, so that this lowest part is thick, the other part of the body thin. The larvæ which are attacked by the 'flacherie' become totally disorganised, and the disorganised parts of the body change into a brown liquid, which contains a very great number of little oil bulbs, and also different species of Bacteria."—J. R. B.

The method of action of the disease is stated to be the beating of the dorsal vessel becoming slower, then a green drop appearing at the mouth of the caterpillar, and the worm secreting a dirty liquid, which soils the anal orifice and closes it. The skin shortly begins to shrivel and draw in round the part of the body between the claw-legs and the sucker-legs, and at this point the body begins to turn brown and then black, and the whole worm is soon in an advanced state of putrefaction. Masses of undigested food will be found in the intestines, and amongst the parasites usually attending putrefaction are a special bacillus, and what is called a chain-ferment, scientifically the *Streptococcus bombycis* of Bechamp.*

The precise cause of the death of the caterpillar is stated to be from the gases evolved by the fermentation of the food, followed by diarrhœa, and the closing of the anal orifice bursting the walls of the intestines. In an account of bad attack to Eri silkworms, considered at the time to be undoubtedly of "flacherie,"† it is stated that when just about the age for spinning their cocoons they stretched back their heads and necks, "reached" several times, and with a good deal of difficulty vomited a thick shiny fluid (of a dirty white colour), and soon died.

* The above short notice of some of the main characteristics of the disease such as are noticeable by ordinary observers without the help of high microscopic powers are mainly taken from the 'Ninth Bulletin of the U. S. A. Department of Agriculture' (sixth edition), 1886, and also 'Indian Museum Notes,' vol. i. No. 3, Calcutta, 1890, pp. 144, 145. In these will be found much useful information on the subject; and in the U. S. A. Report, by Prof. C. V. Riley, quotations from, and references to, the work of Pasteur, 'Etudes sur les maladies des vers à soie,' and that of Maillot, 'Leçons sur les vers à soie du murier,' and other writers. The 'Indian Museum Notes' at pages referred to are mainly, as mentioned by Mr. E. A. Cotes, the compiler, a digest of the U. S. A. Report, and, it may be added, in very useful form.

† See 'Indian Museum Notes,' vol. i. No. 4, p. 200.

Whether the "flacherie" was general in the *C. graminis* larvæ, which came to hand last year for observation, we have not definite proof from specimens reported on *in this country*, for few of us concerned, and unfortunately myself amongst the number, were then fully qualified to identify, but certainly many of the symptoms pointed to this being the case. On the 17th of August, Mr. Robert Service wrote me from Maxwelltown, Dumfries, N.B. :—" I had many hundreds" (of the caterpillars of *C. graminis*, ED.) "in confinement, and of these scarcely 5 per cent. reached pupahood, and the few pupæ nearly all died off also. The larvæ reached their last stage, then died off of a disease that converted their bodies almost into fluid."

In the case of "a large supply of the larvæ of *Charæas graminis*," which were sent by Mr. Service to Mr. Richard South, F.E.S., Macclesfield, Cheshire, Mr. South kindly let me know that these were nearly full-grown, and appeared to be quite healthy when they came to hand; they were supplied with a growing sod, and in a few days disappeared, and, it was hoped, had pupated. However, with the exception of about a dozen which attained the pupa-stage, the entire batch were found dead under the sod. These were almost black in colour, and greatly contorted.

Amongst the specimens under my own observation (not one of which developed beyond the pupa-stage), I found some of the dead caterpillars stiff and dark brown or black, with the head thrown back, and the body burst into a hole below about the fourth segment. The exceedingly bad smell was a point that was only too obvious.

We did not get "flaccid" specimens from the caterpillars at large, perhaps because this was not looked for, but the conditions of carriage of large numbers would be precisely those suited to develop the "flacherie," if present; and from the circumstances of the case, joined to the certainty of the disease being found present in one instance by Dr. Ritzema Bos, it seems to me that we have ground for hoping that this disease, so fatally infectious, was present, and may be ruining its recorded course in so *weakening the next generation* as to free us for a while from recurrence of the pest.

Of the maggot-parasites, one kind was proved, by a few specimens reared to the imago-state by Mr. Service, to be of larvæ of the Tachina flies, which are known to infest lepidopterous caterpillars; another appeared to me, from the formation of the cocoon, to be an Ichneumon infestation, but as I had not the good fortune to develop the insect, I cannot speak with certainty. From the definite record, however, which we have secured of at least three distinct kinds of parasites, or disease being present, we have found that there are powerful natural helpers at work in lessening amount of recurrence of the *Charæa graminis*.

The following notes by Mr. Robert Service, of Maxwelltown, Dumfries, a very well-qualified local observer, appeared in the 'Dumfries Courier and Herald' July 7th, 1894, and will be found to contain much information, useful practically, as well as of entomological interest:—*

“THE ‘HILL-GRUB.’—Sheep-farmers are threatened with another plague, which will in all probability come upon them in full force next summer, should certain conditions prevail till then. For this year the danger seems to be almost past. The ‘hill-grub’ has often done considerable damage to the upland grass-lands, notably in the years from 1830 to 1835. Just now complaints are rife from farms in many parts of the wide district lately ravaged by the Voles. As usual, the farmers look on these ‘hill-grubs’ as very sudden arrivals, but this is not the case, for last autumn the moths which these larvæ produce were in extraordinary swarms, and far in advance of their normal numbers. I remember noting how unusually abundant these Antler Moths were flying at the end of last September when coming down from the neighbourhood of Loch Dungeon one evening in the twilight. The grubs form a regular pabulum for the Rooks at this season, when these birds betake themselves and young broods to the hills. That they are finding this food in great quantities is evident from the way the Rooks are concentrated at particular spots, where the grass-tufts are being torn up in all directions. The other day I received a boxful of these ‘hill-grubs,’ that had been sent for identification from Beninner, in Carsphairn, where they are doing much damage. A party of gentlemen fishing from near the Holm of Dalquhairn for some five or six miles down the Ken found all the trout they caught perfectly crammed with these caterpillars. Old shepherds will tell of times when the ‘hill-grubs’ were so numerous that after sudden thunder-showers the sheep-drains have been completely dammed up with their bodies. It should be noted that the perfect insect is known as the Antler Moth (*Charæas graminis*), and it flies during August and September. It then deposits its eggs, which produce larvæ that descend to and feed mostly about the roots of grasses during the autumn and early winter. After hibernation they commence in March and April to feed again with redoubled energy, and they turn to pupæ at end of June and during July, producing the moths again in a few weeks. Thus their cycle of existence in these various stages extends the whole year round. Their worst natural enemy is the Common Rook, and I have reason to believe that Curlews and Plovers

* These observations form part of a series published by the writer under the geographical *nom de plume* of “Mabie Moss,” this (sometime) moss district having been long under the observation of Mr. R. Service; but in giving these, with some other contribution that Mr. Service was good enough to send me, I believe I am permitted to give the full name.

take a few. Cuckoos also feed upon them, and I have found the stomachs of Snow Buntings shot on the hills at midwinter filled with these grubs."—(R. S.).

In the above notes it will be seen that the Antler Moths were observed in extraordinary numbers in the autumn of 1893, preceding the (also) extraordinary amount of grubs which appeared in the past season of 1894, a coincidence which I believe is not often recorded. It may be remarked in passing that the Ken is a river in the shire or stewartry of Kirkcudbright, N.B., and Carsphairn a district in the northern part of the same county.

In a further communication sent me by Mr. Robert Service, on the 17th of August, he remarked, relatively to the local name of the caterpillars, "that the larvæ of the *C. graminis* have been known here from time immemorial,—or at least since the beginning of the century, when sheep were substituted on the uplands for black cattle,—as the 'hill-grubs.' They are easily and quite correctly distinguished by the shepherds, in their ravages, from the 'Jenny-spinner' (*Tipula oleracea*), which sometimes devastate the pastures." After some remarks, which I have quoted at p. 19, on a disease affecting the caterpillars whereby they were turned almost into fluid, Mr. Service continued:—"So far as I noted this disease did not affect those at large, but bird-foes, thunder-rains, and other causes killed the wild larvæ off in vast myriads."

"The moths are out now" (Aug. 17th, ED.) "in fearful abundance, and will continue, I expect, for another couple of months." . . . "I did not notice any Threadworms amongst my larvæ, and only one or two Tachinid pupæ were seen. The flies duly hatched, and to my great disappointment escaped when I opened the glass rather incautiously. They looked like small specimens of *Echinomyia grossa*."*

* The Tachinids are a division of Diptera, or two-winged flies, of which the larvæ or maggots are parasitic in other insects, and those of the genus *Echinomyia* especially infest caterpillars. They are noted by Macquart ('Histoire des Diptères,' vol. ii. p. 71) as remarkable amongst the Tachinids for the size and thickness of their bodies; and the *E. grossa* is especially noticed by Schiner ('Fauna Austriaca,' vol. i. p. 425, for its size and beauty. The main colours are shining black with some yellow; the dimensions given by Walker ('Insecta Britannica,' Diptera, vol. ii. p. 19) are 8 lines in length and 18 lines in spread of the wings.

The larvæ or grubs of the Tachinids are described by Dr. F. Brauer as thick, cylindrical, flattened at the under surface, with the segments furnished with distinct transverse swellings, which are either naked or girdled with fine short teeth or prickles, &c. They appear to have no head, but have two spiracles on the hinder end, &c. The above is from the third part (published in 1883) of Dr. Brauer's Diptera of the Royal Museum of Vienna; and I am greatly indebted to the kindness of Mr. R. H. Meade, of Bradford, in letting me have this extract, as I had not the opportunity myself of referring to the above.—ED.

In the further remarks of Mr. Service on coincidence having been noticed between locality of attack of the Voles, his notes of the change in the state of pasturage or herbage consequent on Vole-workings, from rough coarse conditions to succulent fresh growths, precisely agree with the description given by Kollar, and also by Curtis, that the food of the caterpillars consists of "all kinds of tender grass," or "of all the soft sorts of grasses." Mr. Service observed:—"I see you refer, in the August Ent. Monthly Mag., to the 'hill-grubs' being found in the same places as the Voles. As the latter were found to a most destructive extent in *practically all* of the sheep farms of the southern uplands, the 'hill-grubs' could hardly increase to a visible extent on any of the sheep grazing lands without getting into grass that had been so lately eaten down to the roots by the Voles. But the point is this, although Prof. Wallace leaves it to be inferred: after the sudden disappearance of the Voles the grass sprung up with great luxuriance. The Voles had eaten off all the great tussocks of perennial herbage, rushes, sedges, &c., some of it the growth of years, and the new verdure was of the greenest, freshest, and most succulent nature; and some of the herds and sheep-farmers state that in all their lives they had never seen anything like it on their hill-sides. And the question thus arises, did this fine, luxuriant, *new* crop furnish the pabulum required by the 'hill-grubs' before they could multiply to plague numbers?"

On the 31st of August Mr. Service wrote me that "On Thursday (yesterday) I saw a wonderful sight on a hill-side in Upper Nithsdale, on a farm where the 'hill-grubs' had not been conspicuously present. About 10 a.m., when I arrived at a place where *Juncus squarrosus* was the prevailing plant, the Antler Moths were in full flight,—in thousands and thousands in all directions. This flight continued till well after midday, when it in a great measure ceased, although the moths were to be seen here and there the whole afternoon. Just before the gloaming they again began to fly very numerously."

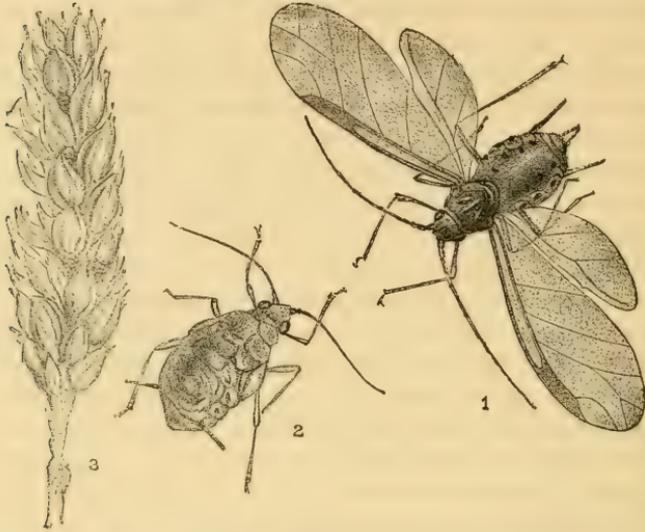
SUMMARY AND MEANS OF PREVENTION AND REMEDY. — The special points noticeable in last year's attack were the large area over which the infestation extended, also that in a portion of the area, presence of the Antler Moth had been noticed in great numbers in the preceding autumn (that of 1893), and that again, after the great caterpillar infestation, in due time there was another enormous appearance of moths in the autumn of 1894; these preceding and following appearances, so far as I know, have been little recorded, nor has the great amount of parasitism which we found existed in 1894 been previously recorded. This point is well worth further investigation.

In regard to remedial measures, the chief hope seems to be in

taking advantage of their habit of migration. They are found to object greatly to burnt surfaces, and to move off rapidly where the travelling parties come on fired ground. This plan therefore might apparently be serviceable in checking advance where their presence was likely to be especially injurious; also it might be used for directing the moving caterpillars to where by natural or artificial means they may be destroyed. A mountain stream is a most convenient place for their course to be directed to (see p. 20), or a pool, or a pit with water at the bottom, or deep ditches may be made. If full of water they will destroy great numbers, but a dry hollowed-out space or kind of broad ditch may also be made to serve well; it is said that by driving sheep to and fro where the grubs are thus collected in a narrow space whilst on their travels great numbers may be destroyed. The same treatment, or any kind of treatment which would crush them, would be equally applicable in cases where (see p. 15) they were seen in great bodies going down the hill-paths, or where, as in the great infestations of 1816 and 1817, the roads, and more especially the ruts in the roads, in the Hartz district were so filled with the caterpillars that their crushed bodies made the way dirty and slippery.

Driving pigs on the infested ground is a measure particularly advised for clearing the caterpillars, and doubtless would do well where it was practicable, but this would by no means be so in all cases. Probably where weather and the various circumstances allowed, the best preventive of recurrence would be well-directed firing of whatever infested land the treatment could properly be applied to, as in the case of the Glamorganshire attack of 1884 (before alluded to), in which special mention was made of the localities of attack being noticeable, when standing on the ridge of the Ogmores Valley, by the smoke of the mountain fires which were seen to the west, where attempts were being made to destroy the pests; in this case presumably effectual, as no further reports were sent of presence.

Corn and Grass Aphis. *Siphonophora granaria*, Kirby.



SIPHONOPHORA GRANARIA.—Winged female and young Aphis, magnified (after Buckton); infested Wheat ear.

Corn Aphis is more or less present every season on Wheat and Oats, and sometimes to a seriously injurious amount; but if present as a Grass pest, it is so rarely reported to the mischievous extent to which it was noticed last year in the neighbourhood of Newcastle-on-Tyne, that a note of the observation seems worth record.

On the 30th of May, Messrs. S. Finney & Co. wrote me from Newcastle-on-Tyne as follows, with specimens accompanying:—"We beg to enclose you some Grass and Clover that have been attacked by the Green Fly, which are doing an enormous amount of damage in this district; the specimens are taken from a 15-acre field, which is almost totally destroyed, and they are beginning to spread to other fields in the neighbourhood. They appear to be most troublesome on land that has been laid away for two or three years Grass, and so far they have not touched the one-year Grass and Clover."

The large packet of specimens sent accompanying showed this to be the worst case of Aphis infestation on Grass that I had ever met with; and on June 2nd, Messrs. Finney further wrote me that the Green Fly appeared to be spreading rapidly to other fields in the neighbourhood.

On very careful examination of the Aphides sent, there did not appear to me to be any reason to doubt that they were the Corn Aphis or Plant Louse, scientifically the *Siphonophora granaria* of Kirby, also known as the *S. cerealis*, and also as the *Aphis avenæ*. Still, although

this feeds on many kinds of Grass, from the unusual virulence of the infestation, and also from there being a slight difference in the disposition of the black markings on the green abdomen of the winged females from what is considered the typical colouring, I thought it possible a variety might be present, and therefore submitted my doubts and also specimens to Mr. G. B. Buckton, F.R.S., our great authority on Aphides, who kindly replied as follows:—

“An examination of the Aphides you sent to me leads me to the conclusion that the pest is the *Siphonophora granaria* of Kirby, that is, *S. cerealis* of Koch and Passerini, and *A. avenæ* of Schr. The only hesitation would seem to depend on the more or less distinct barring on the abdomen of the winged females. The spots are named by authors, but not the bands.

“*S. granaria* feeds on many kinds of grasses, as well as the true cereals. I think it not improbable that the description of food modifies colour (I find it so in Indian Aphides); and again, some of your specimens had only traces of these transverse bands. Hot weather gives redder tinges to the later broods. This may be noticed also in *Aphis rapæ*. The presence of several parasitic Hymenoptera (*Ephedrus* of my plate) confirms me in my opinion, and they show the farmer that these flies are still looking after his interest.”—(G. B. B.)

These various points I entered on at the time in my reply to Messrs. Finney's enquiries; but as this early form of attack, whether to corn crops still in the blade, or to fields of growing Grass, necessarily differs so much in locality from the damage caused later on to corn ears, or to seed-heads, as possibly to admit of some remedial application, I give below a part of my letter of May 31st with some additions:—

“I have carefully examined your ‘Green Fly’ specimens in winged, pupal, and also in larval state from very first production, and I do not see that there is any reason to doubt that they are the *Aphis* (*Siphonophora*) *granaria*, sometimes known as *cerealis*. I should not like to speak quite positively, because this *Aphis* varies at times so very much in colour that it may be red, green, brown, or yellow, and it is known under several names; but, taking a common-sense view, I think it is the common Corn and Grass *Aphis*.

“Besides, what may be distinguished as corn, such as Wheat, Oats, Barley and Rye, this kind of *Aphis* is known to infest many kinds of grasses, some of these of the customarily cultivated kinds, as some of the Poas or ‘Meadow Grasses,’ Rough Cocksfoot, and other kinds of less agricultural value, or none at all, as various kinds of *Holcus*, or ‘Soft Grasses,’ the Soft ‘Brome Grass,’ the very common field-path and roadside growing Wall Barley Grass, the *Hordeum murinum*, the *Avena fatua*, or Wild Oat, and others. We do not, so far as I am aware, know certainly in this country where the Corn and Grass

Aphides have their winter habitat, but from the fact of these Aphides being found in other countries sheltering at the roots of Grass or corn during the winter, it is very probable that they do the same here, whether in egg or active state, although (so far as I am aware) we have not yet had any definite observation of this happening. But this would, I think, agree with your own remark that 'they appear most troublesome on land that has been laid away for two or three years Grass, and so far they have not touched the one-year Grass and Clover.'

"At this time of year the infestation is to be found on the blade or stem of the corn, or, in your case, of the Grass, where (as your specimens show) they can do enormous mischief. This is not only by drawing away the juices by means of their suckers, but also by the great damage caused to the tissues from the Green Fly (from their first production) driving their suckers into the soft parts.

"I never yet saw such a severe Grass attack, and I am sorry to say that they may be expected to multiply rapidly. At this time of year and till autumn, they multiply by being produced alive, all ready furnished, like the fully developed specimens, with six legs adapted to active movement, and a sucker for piercing into their food-plants; and such of the females as pass to the winged condition carry the infestation far and wide. Presently (in ordinary course) it may be feared that where corn is in the neighbourhood the infestation will appear on the leaves, and then do infinite mischief by extending to the ears.

"This is the stage of attack in which (later in the year) I usually receive specimens. Then these 'Plant Lice' lodge in the ears, and by piercing into the main stem and the side stems of the ear, they prevent the grains swelling properly, and yield a shrivelled, more or less injured return. In this condition (that is on the ears) the Aphides are very often in great part brown; but, as above mentioned, there is no reason to doubt that they are of the same species as those now under consideration."

PREVENTION AND REMEDY.—In the above, or any similar case where there might be a definite centre of attack in a large Grass field from which the infestation was spreading, the best treatment for the safety of the neighbourhood would apparently be to mow the infested Grass as soon as possible, and then so to treat the short hay that it might remain also for as short a time as possible, in a state for the Aphides to continue to live on it. Thus all the wingless Plant Lice on the cut Grass would be killed, and excepting from such of the others as might fly away, infestation from this source quite stopped.

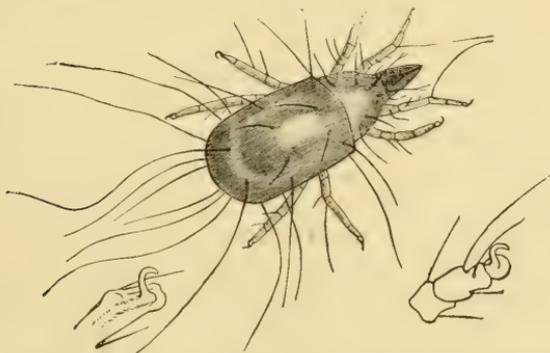
A dressing of any kind preferred, which would both be bad for any Aphides remaining on the ground, and also push on a good growth of

Grass, would be serviceable, and any wash or dressing which would run on growth would be beneficial, independent of all other considerations, as Aphides multiply most rapidly on sickly plants.

All the ordinary applications that would be suitable are too well known to need mention; but where there may chance to be any mill in the neighbourhood from which soft-soap wash has to be removed, this would be an excellent preventive and restorative also.

Whether any remedial measures could be serviceably used to such an infestation as the above whilst the Grass was still growing, or on a young growing corn crop before it had shot into stem, would much depend on whether sprayers could be brought to bear. If a horse spraying-machine could be used without damage by crushing or trampling, there appears to be no reason why the various kinds of soft-soap washes that are known to be serviceable for getting rid of Aphides on other crops, as Hops, or on orchard trees, &c., should not answer just as well here. The species are different, but they are so similar in nature, that remedies which act on one kind would answer also for another, and the common soft-soap wash, or soft-soap and paraffin, or soft-soap and sulphur, or again, soft-soap and quassia, might any of them be expected to do good, if, as above observed, the method of application could be so managed as not to trample down or bruise and waste the growing crop.

Hay Mites. *Tyroglyphus longior*, Gervais.



TYROGLYPHUS LONGIOR.—*T. longior*, from figure by Fumoze and Robin; claw with sucker of *Tyroglyphus*; right-hand side, from Murray's 'Aptera'; left-hand side, figured by Ed. from life: all magnified.

During the past few years the occurrence of Mites in hay, or rather as appearing from haystacks, and from hay stored in lofts, in such vast numbers as to lie in masses round the stacks, or beneath the loft

windows, has often been reported, in a few instances from English and Irish localities, but chiefly from Scotland. As the infestation had been carefully identified, and the presence of these, literally, "heaps" of Mites, though very unsightly, is really almost or quite harmless, it would have seemed unnecessary to bring the matter forward again, had it not been that amongst this autumn's observations there has been one on such a large scale, that the enquirer had been seriously advised to burn his infested stacks.

This enquiry was forwarded on to me per favour of the Editor of the 'Scottish Farmer,' and will be found in the number for Oct. 13th (1894) of that Journal, p. 813, in the following words:—"My hay is all covered with Mites, and on application to local experts, I am advised that the only remedy is to burn the stacks. Can you suggest anything less summary?" To this, of course, I replied that on no account would I advise such destruction; but as it appears the nature of this infestation is not sufficiently known for such a course to be possible, it may be useful to give a digest of what is known about it up to the present time.

These Mites (which in the absence of any popular name it is convenient to describe as Hay Mites) are scientifically the *Tyroglyphus longior*. They are exceedingly like the "Common Cheese Mite," the *Tyroglyphus siro*, and, like it, are at times to be found in cheese; but they are larger than the Cheese Mite, longer in proportion, have much longer hairs, and are more active. The rapidity of movement, and the length of the hairs of the adult specimens, I have found very noticeable in microscopic observation. The figure (p. 27) gives a very good idea of the appearance, much magnified, and also shows the single claw which (with the sucker also), at the end of the leg, is characteristic of the sub-genus *Tyroglyphus*.

Like most of the order of *Acarina*, or "Mites," to which they belong, they are hatched from eggs, and (also like most of this order) in their early stage have three pairs of legs, and, when mature, four pairs. When seen in small numbers, and without magnifying powers, they are indistinguishable from the common Cheese Mite; but when fallen down in the vast numbers in which they are from time to time observed in autumn, they are like masses of live, slightly moving, greyish dust. They occur as dropping from haystacks, or from lofts where hay is stored, in quantities described as shovelfuls, or as lying an inch or more deep round stacks, or the hay itself being alive with them. In one report sent me from Swaffham, Norfolk, on the 25th of August, 1892, the Mites were described as having been dropping on the ground in vast quantities for several days from a stack of that year's hay, and that they lay in masses of many quarts heaped up upon the ground. A report from another correspondent from near

Bury St. Edmunds in the same year and at the same date, mentioned the Mites as then making their appearance from a stack of Clover saved for seed; that the stack was covered with them, and (the observer wrote) "I could have no difficulty in sending you a peck of them."

Yet another observation sent much later, namely, on the 16th of November, in the same year, from near Garve, Ross-shire, N.B., mentioned that from weather circumstances the haystack from which the Mites were sent me was not made up from the large rucks in which the hay had remained until late in September. About a month after there were severe frosts (15° Fahr.), and the following day, on each side of the stack, there was a layer, about two inches deep and six to eight inches wide, of these Mites, and at date of writing (16th November) considerable quantities still remained.

The above notes show the extraordinary quantities in which these Mites occur from time to time in autumn. I do not remember their presence being reported in these great quantities later than the above date, that is in the first half of November, but I have had a note of Mites being found in April with seed taken from the floor of a hayloft near Skene, Aberdeenshire.

Where the Mites feed and breed during summer is the point which we especially want to know with certainty. The hay in which they are found is in most cases reported to be good hay, or well-saved hay, or some term used to show its good condition; and in a note by Mr. John Speir, of Newton, near Glasgow (a well-known authority on farming matters), he remarked, in reply to some of my enquiries:—"No one need annoy himself about having Mites in his hay, as it is only well-saved hay which produces Mites." The point which suggests itself on comparison of the different reports is that in all probability the Mites are very generally present in hayfields, but that the amount of their presence in the stacks is very much influenced by what may be the treatment of the grass between the time of cutting and of stacking, and also by the amount of heating, or absence of heating, of the stack.

I have had two reports of Mite presence from Ireland, a few from England, but most of the returns have been from Scotland; and amongst these I find special allusion to hay being collected in large cocks or tramps in the field, and these being carried at convenience, or when weather permits. In one of my two Irish reports, I find the same kind of treatment noticed. This was at Knockreven, Clonmel, in 1886, and it was mentioned:—"It is second crop hay, which was cut about the 20th of August, and saved without rain; but it remained some time in cocks on the field." . . . "The rick heated a little for about ten days after it was made, but only slightly, as the hay is now coming out good."—(T. R.)

A note with which I was favoured by Mr. Colin Campbell, of Jura, points also to preparation of the hay affecting the amount of Mite presence. In reply to some of my observations, Mr. Campbell wrote:—"There is no doubt that it is more of a northern infestation; and in Scotland it is not the practice to allow hay to heat, which may account for their being present. It is generally the case that good well-saved hay is most infested."

Mr. Campbell further remarked in some observations which he sent to the 'Agricultural Gazette' after reading my Report for 1890:—"Mites in hay.—Some five and twenty years ago, when a lad going about the home farm at Jura, N.B., I often used to wonder at the quantity of light-coloured dusty-looking material that used to drop on the window-sills of a large haybarn (stone and slated)"; . . . this—Mr. Campbell mentions amongst other details—he further investigated, and found it was a mass of living creatures corresponding with descriptions given of the Hay Mite, and he notes:—"The hay stored in this barn was always first and second years' Rye-grass hay, which never heated, as it was allowed to stand a considerable time in tramp ricks in the field to season, as it had to go into this built barn."

These notes, amongst other information sent, point to the special presence of the Mites being in stacks little heated, as the stacks have been built of hay which has for some time been cut and standing in large cocks or tramps in the field or yard before being stacked.

The following observation gives a good record of the Mites being found present to a very unpleasantly noticeable extent in these cocks. The notes were sent me on Nov. 6th, 1891, by Mr. Thos. Fraser, from Ardfin, Isle of Jura, N.B., as follows:—"It is the general practice in haymaking in the West of Scotland (West Highlands), as soon as possible after cutting or mowing (which ranges from the end of June to the end of August), to have the hay collected in large tramps or cocks on the field, where it is allowed to remain some time. The first appearance of the Mites (to an ordinary observer) is when removing the said cocks, or tramps, from the field.

"While forking the hay from the bottom or lower part of the cock on to a cart, at a much higher elevation, it is necessary to raise the hay *overhead*, and in minute particles, like dust, the Mites fall, and from the backward position of the worker's head at the time, they stick or adhere to the face in a very short time, causing itchiness or irritation on the skin. At this stage, I think, they are less in size than when they are found a fortnight or so later on emerging from the recently made stacks." (This observation points to the Mites which have to go through various moultings before arriving at complete development, being still young when thrown in the hay from the cocks to the stack. In the samples sent me, I have found the Mites of different ages, as

clearly shown by some having three pairs and some four pairs of legs.—ED.)

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

Looking at the history of this infestation in the light of the information sent in up to date, it appears to me that the origin of the Mite attack must be in the grassfields. There does not appear to be any other way from which it could get into the cocks, for this reason—that the cocks are made of the hay grass, and whether the Mites are thrown and raked into the cocks in the hay, or come to the cocks from the mowed grass, these Mites equally come from the grass, or from something amongst it.

In the information given regarding this infestation by Mr. A. D. Michael, the eminent Acarinologist, to whom we were indebted for identification of this species (see 'Farmers' Gazette,' Dublin, Dec. 25th, 1886), he mentioned regarding this Mite that it and many of its allies would attack an immense variety of dead and dried animal and vegetable substances, but they did not, so far as his own experience showed, attack either in living condition, except that they appear sometimes to eat small fungoid growths; neither do they, as a rule, like substances in a state of decomposition.—(A. D. M.)

There appear to be numbers of things on which the Mites *might* live, including pollen of the grass-flowers; but how to ascertain what it is that they *do* live on is a matter of no small difficulty under the circumstances, and with creatures which, except in masses, are hardly discernible by the naked eye.

The absence of heating of the hay which is so customarily mentioned in observations of this infestation might very likely affect amount of the Mite presence. In my own experiences in Gloucestershire where, on my late father's property at Sedbury Park, there was much hay stacked both at the home farm and those of the tenants, it was the custom to get the hay up as soon as possible after cutting, and also heating was carried not unusually to the verge, or sometimes over the verge of safety, I never, in the many years that I observed what was going forward, saw or heard anything of Hay Mite infestation. Why the Mites leave the stacks in these legions, we have no evidence as yet to show. One correspondent suggests that it may be in case of a sweating or slight fermentation of the hay; from another we have definite notes of this extraordinary Mite exit coinciding with occurrence

of sharp frost. It appears to me worth investigation whether it may not be from time for egg-laying having come in connection with the full growth of the *Acari*, and that they simply instinctively leave the stored hay in search of the proper places for egg-laying. This point I have not yet had opportunity for investigating, but it would be well worth going into by those who have the immense numbers at hand for investigation; or if half a handful or so were sent to myself for examination, I should hope to have no great difficulty in ascertaining to what extent eggs might be present.

In regard to any prejudicial effect to stock feeding on the Mite-infested hay, a point which is often enquired about, it is satisfactory that, so far as has been reported at present from careful observation, no harm whatsoever has been found to arise from this cause, excepting the sometimes temporary inconvenience of coughing being caused from the tickling of the Mites in the throat. Mr. Colin Campbell, in his communications previously referred to, especially observed, in reply to enquiries on this point, that the Mite-infested hay, regarding which he wrote, "was fed to a large fold of in-calf Highland cows, young cattle, horses, and dairy stock, without doing them the slightest harm, or producing any ill effects."

Mr. J. England Wilson, whilst still resident near Skene, Aberdeenshire, wrote me on this point, with specimens accompanying of Mites from hay "well seasoned, but not heated in stack":—"Horses eat it, but cough very much, owing no doubt to the Mites irritating the windpipe."

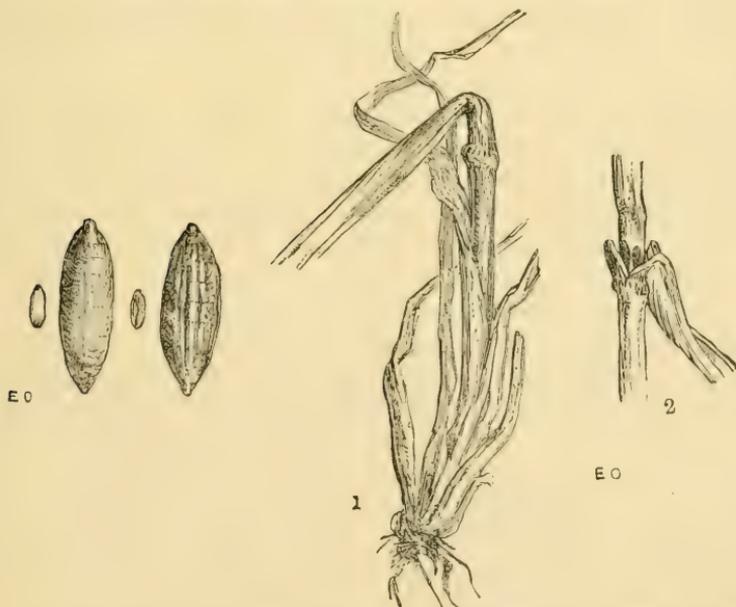
Not having opportunity of observing the details of this hay infestation myself, I cannot say whether this coughing, which is certainly undesirable, often occurs, but I do not think that any other observation of it occurring has been forwarded. If it happens to an extent worth consideration, might not the annoyance be abated or entirely put an end to by moistening the hay before use? It might be expected that this would make a great deal of difference in the active powers of the infesting Mites, so that they might be swallowed, together with the food, in a condition that would effectually prevent the tickling. I would not venture myself on suggesting any special method of treating cattle or food; but in Youatt's 'Complete Grazier,' 13th edition, 1893, re-written by Dr. Fream, is the following observation:—"It is the writer's opinion that if farmers can make good hay, and will moisten some of it—not soak it—for a few hours before feeding it to the cows, they will feel no need of silage."—(W. F.) If experiment showed that this treatment would keep the Mites quiet, so as not to give trouble by tickling the nostrils, face, or throat of the stock, this would be a point gained.

How far salt, sprinkled on the hay, or any other dressing known to the farmer not to be hurtful to the animals, might succeed in driving

away Mites from the fodder about to be used would also be worth consideration; for this Mite infestation has now been before the public since at least 1886, and we do not seem to have made the least advance by way of experiment towards lessening what amount of annoyance stock may find in consumption of "mity" hay.

Where the great masses of Mites are found congregated together during their exit from stacks or lofts, one of the simplest ways of getting rid of them would seem to be to shovel them up and destroy them. To dig a hole and throw them in, and put a little tar on from time to time during the operation, and a band of tar round the inside of the hole, to keep them from crawling up the sides before the work was completed, with some tar on the top, would be a very effectual measure. Burning all rubbish in which the Mites congregated (after removal to a safe distance from the stack), would also help. And in lofts where infested hay has been stored, scalding down the floor with a good soft-soap wash, and whitewashing the walls and all accessible parts, taking care to get the applications into every cranny that can possibly be reached, would do good. Where steam-power is at hand, throwing jets with the help of a hose is a most excellent method for clearing vermin, whether Mites, maggots, or others, from lofts or granaries after presence of infested stores.

Hessian Fly. *Cecidomyia destructor*, Say.



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

During the past season scarcely any observations as to presence of Hessian Fly were sent me, certainly not more than two reports of it having been seen in addition to the following remarks from Mr. D. D. Gibb. It would not be worth while to allude to this attack again save for the weather returns which Mr. Gibb furnished me with along with his insect observations. These show the coincidence of much rain with a growth of plant which prevented the injury being noticeable to the extent that occurs where drought throws the plant much under the power of the maggot sucking away the juices from the stem, and it seems well worth while to give the record, for it is not often we can secure reliable weather notes, coincidentally with those of crop attack in one special locality.

It seems almost unnecessary to mention that with this crop attack the mischief is caused by the Hessian Fly maggot, or sometimes several of them, remaining stationary under the sheathing-leaf a little above a knot in the stem (probably one of the lower knots) and sucking away the juices. If the stem is weak, either from influences of drought, or of bad cultivation, or any other cause lessening its strength, it presently does what is called "elbows down"; that is, it gives way at the weakened part and falls (see figure) at a sharp angle or elbow. Thus, in addition to what damage may have been done by lessening the supply of food to the ear, there is the damage to be considered from the ear lying either on the ground or near it, and also the difficulties in reaping from the entangled state of the crop, and further loss from the amount of ears which may be left behind on their fallen stems.

The figures at p. 33 show an "elbowed" stem, and the flat brown cases, commonly known as "flax-seeds," these being the chrysalis cases, or puparia, to which the maggots turn at their feeding-places,—beneath the sheathing-leaves. The "Hessian Fly," scientifically the *Cecidomyia destructor*, is a stout made little brown gnat-like fly, about one-eighth of an inch in length, with one pair of smoky-grey wings, and with long antennæ, or horns.*

The following observations were sent me on the 30th of June by Mr. D. D. Gibb, from Ossemsley Manor Farm, near Lymington, Hants, with specimens of Hessian Fly puparia, commonly known as "flax-seeds," on Wheat stems accompanying. Mr. Gibb reported:—"When in one of our Wheat-fields this evening, I came across traces of Hessian Fly attack. As the crop is a good level one of stiff-strawed Red Wheat in full bloom standing about five and a half feet in height, the damage cannot be said to be great, yet puparia can be found, and the damage will be more apparent at a later stage. I send

* The figure and description have been so often given in these Reports, that it seems unnecessary to repeat them.

specimens herewith, from which you will see the flax-seeds are for the most part to be found at ground level. There are also some stems (apparently slender or delicate ones) entirely shrivelled up; inside one of these I found a brown pupa bearing a close resemblance to those of the Hessian Fly, except that it seemed longer and not so flat. The next found I put into a quill and send for your inspection herewith, without removing from its abode."—(D. D. G.)

The specimens sent I carefully examined, and could not find any reason for considering them other than "flax-seeds," that is, Hessian Fly puparia; and the shrivelling of the stem seemed to me quite attributable to the attack acting on an already weak growth.

Mr. Gibb further noted that,—“This crop of Wheat was sown late in November, and was kept in check by rabbits during the winter and spring that few blades were to be found three inches in length until well on in April, when, after harrowing and rolling (but no dressing of manure), it grew very rapidly, and now looks like yielding 5 qrs. per acre.”

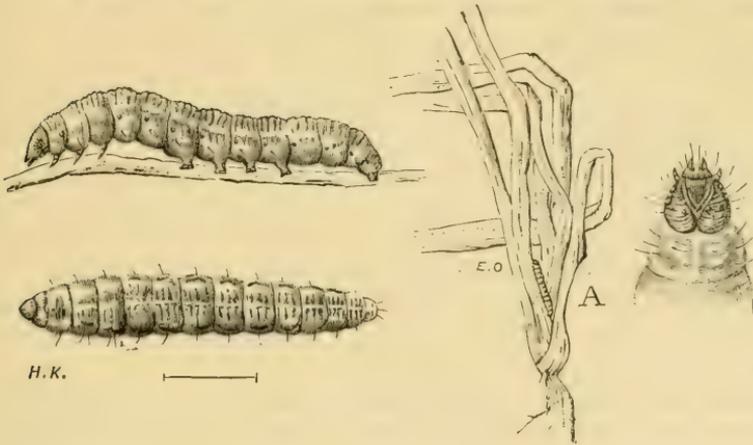
On the 26th of July Mr. Gibb wrote that he had little to add further regarding the Hessian Fly infestation, of which he had, as above mentioned, sent specimens, but that “the presence of the pest can be traced in most local crops of Wheat and Barley, but the damage cannot be termed serious. The season having been so favourable for plants tillering or shooting afresh where injured by this or stem maggot pests, crops of cereals are very much over the average.” In another part of the same letter, Mr. Gibb (referring to attack of Diamond-back Moth) mentioned, regarding influence of weather on growth of crops:—“The constant showers which have been very trying to those engaged in haymaking operations, have caused a very rapid growth of Swedes and other root crops.” And two days later, he noted that “yesterday and to-day we have had a change for the better in the weather,” thus showing the unfavourable weather had lasted up to date.

In the following letter, accompanying specimens of Hessian Fly flax-seeds which I had asked for if still observable, it will be seen that Mr. Gibb notices the large amount of presence of the pest, but that this was less noticeable than it would otherwise have been on account of the moist season having kept up the vigour of the plant. This was written on the 25th of August, and, like the preceding observations, from Ossemsley Manor Farm, Lymington, Hants:—“I have much pleasure in being able to supply you with a few stems of Wheat and Barley containing some specimens of Hessian Fly puparia *in situ*. In some of these I believe you will find several ‘flax-seeds’ clustering around one stem. Unfortunately there is very little difficulty in finding specimens, the pest having been severe, although the moist

season has made it less apparent by keeping up the vigour of the plants. The Wheat is all cut in this locality, and the greater part carried in the beginning of last week; there are many indifferent samples among those threshed, and the price for the best varies from 23s. to 24s. per quarter. The stems sent showing infestation were picked from among the stubbles; from having elbowed down they had escaped cutting. The Barley stems were taken from the growing crop of a tenant on this property, and I did not require to go off the headland to find what I wanted." To this Mr. Gibb added the following note as to heavy rains, which may prove of some interest to record relatively as to what may be the amount of presence or absence of Hessian Fly in 1895 amongst Wheat or Barley growing where, presumably, very many of the flax-seeds must have been destroyed by lying in the wet. Mr. Gibb observed:—"Should you require a further supply, please let me know soon; it may be more difficult to send a supply later on. Since Monday, the 20th inst., we have not had a dry day, while on Friday and Saturday there have been terrific thunderstorms with such abundant downpours of rain as to cause flooding, damage to bridges, &c., and some low-lying ground is still under water."

Measures of prevention and remedy have been too often entered on to need further reference; but it may be remarked that *the* great point to prevent recurrence of the attack is to destroy the "flax-seeds"; that is, the flat brown chrysalids from which a new brood of the Hessian Fly might be expected in due time to appear. For what remain on the field, where stubble is not mixed with other crop, deep ploughing of a kind to bury the flax-seeds thoroughly down, and leave them buried, is one of the best modes of treatment. If the furrows are only turned so that the position of the slice does not fairly bury down the chrysalids, the fly will be very likely to develop uninjured, and make its way out.

For what are carried from the field on the reaped corn, the simplest treatment is to burn or destroy them in the light rubbish thrown out by the threshing-machine. This is of no value, and as these light screenings lie together with the flax-seeds in them, it is little trouble or expense to have them gathered up and destroyed in whatever may be the most convenient manner. It is now eight years since the Hessian Fly was first observed in this country as certainly present as an agricultural pest, and the experience of those years give reason to hope that it will never be the scourge here that it is in some of the other countries to which its presence has spread in recent years. Nevertheless it does quite enough harm here, and needs watching.

Young Wheat Moth Caterpillars. *Miana* (? *expolita*, Dbl.).*

Caterpillars, upper and side views, and head, all much magnified; line showing nat. length; Wheat plant with caterpillar in centre.

The following observations refer to a species of small moth caterpillar which was observed early in the year doing serious injury to a field of young Wheat near Lymington, Hants, by feeding within the centre of the plant, and also to some degree eating the young leaves round the centre. The first note of its presence was sent me on the 21st of February, by Mr. H. Renyard, of Carter's Farm, Norley Wood, Lymington, Hants, with the remark:—"I have sent the enclosed maggots to you, which I find my Wheat full of. They are destroying the whole crop."

A few days later (on February 26th) Mr. Renyard forwarded me some more specimens of the caterpillars, with the further observations:—"I only find them in the lay ground. Where I ploughed it in fallow in the same field the Wheat looks well, but where these maggots are they are destroying the whole crop. They eat the heart clean out of the corn." . . . "I have enclosed several maggots in the heart of the corn."

The young Wheat plants sent showed the serious nature of the damage. This was in various stages,—as the whole of the centre of the little plant being cleared out; or the central shoot being bitten off; or the mischief being then in progress. In most instances the little brownish backed caterpillar was set head uppermost, either in the middle of the plant, with moist morsels of material in the cavity, apparently composed of "frass" (or the rejected results of feeding), or sometimes supported along the back by one of the sheathing-leaves, so

* For considerations of species see following pages.

that it could gnaw away the more central part at convenience. The caterpillar, however, appeared to have an especial preference for so arranging itself in the central shoot, or emptied sheathing-leaf of this part of the young plant, that it formed a cylindrical shelter for each larva.

It may be of some interest to notice in passing with regard to this little moth caterpillar attack, which so much resembles that of the Wheat-bulb Maggot (the larva of the two-winged fly, the *Hylemyia coarctata*) in the method of injury, that whereas the *H. coarctata* infestation is especially prevalent after fallow, it was just the contrary with the moth caterpillar. Mr. Renyard notes that the Wheat after fallow looked well in the same field, where that after ley was seriously injured. In case of recurrence of this kind of infestation this point may be worth observation practically.

The caterpillars proved to be larvæ of one of the smaller kinds of Noctua moths, and exceedingly resembled the description and also the figure of those of the *Miana exopolita* given in Buckler's 'British Butterflies and Moths.'* After much consultation there appeared little (if any) doubt that it was of the genus *Miana*, but none of us were fortunate enough to rear the moth, so as to make sure of the species. Therefore as this kind of attack to young Wheat does not appear to have been previously observed, and is certainly very mischievous, I have given as clear a description of the characteristics of the caterpillar as I was able, and also a much magnified figure of the upper and side view, in order to preserve at least a record of so much as we were able to observe.

The caterpillars sent me were up to five-eighths of an inch in length; sixteen-footed (that is, with three pairs of claw-feet, four pairs of sucker-feet beneath the body, and one caudal pair). The shape slender, cylindrical, or rather larger towards the third segment. Head reddish-brown, darker in the fore part, and in the most characteristic specimens somewhat wedge-shaped, narrower than the next segment,—this especially noticeable when the larva was at rest, with the head slightly contracted into, or drawn close up to, the following segment (see figure, p. 37). General colour yellowish; segment next the head with a horny or shiny patch above, slightly marked across with yellowish red or yellowish brown; next two segments with a small blotch of the same colour; the rest of the segments so marked similarly on the upper part and side, as to have customarily only a narrow line of the ground colour showing down the centre of the back, with two transverse stripes of the same across the top of each segment.

* See Buckler's 'British Butterflies and Moths' (Ray Society), vol. iv. pp. 103—106; plate lxxviii. fig. 5.

Beneath these cross markings is a light longitudinal band, and lower yet, on each segment, three light cross markings on the brown tint. The brown marking only reaches as far down on the side as the little black spiracles. The claw-feet were brown; the sucker-feet of the light general tint of the body, tipped with darker colour. The much magnified figures of the caterpillars at p. 37 give a fair idea of the disposition and shape of the markings.

Being very desirous to rear the caterpillars up to fully developed state, I put some of those which I first received towards the end of February, or early in March, on very young shoots of ribbon-grass, and attended to them carefully, and also watched some of those in the Wheat plants, but without satisfactory results, as they died successively by about the end of March.

Some little information, however, was attainable. So far as appeared from watching the small number of specimens, the reddish-brown markings of the caterpillars deepened in tint with advance of age. It could not be said with advance of growth, for on this point there was very little difference, as from date of first observation to finding the last remaining of the specimens sent they had been dead a short time, on the 4th of April. Whether this was wholly from unfavourable circumstances, or partly from completion of growth, appeared uncertain. The ribbon-grass was to some degree acceptable as food, for in one instance a larva ate out the central part of a ribbon-grass shoot, reducing it to an empty cylinder, slightly spun together with a little web. Some of the caterpillars concealed themselves temporarily in the earth, but none passed on to the chrysalis stage.

In my great difficulties as to anything like certain identification of the species of the larvæ, I submitted specimens, or the figure at heading, together with descriptions, to various lepidopterists, who were good enough to go into the matter, and I think I may say that they mostly agreed in considering the larvæ were of the genus *Miana*, but of which species of this genus they were remained uncertain. I am particularly obliged to Mr. John Robson, and also to Mr. J. Gardner, both of Hartlepool, for kindly taking a deal of trouble in going into the matter, and I am bound to say that neither of these skilled lepidopterists, who are well acquainted with the larvæ of *M. espolita* (for various reasons unnecessary to go into fully here), considered it likely the caterpillars should be of this species, but rather one of the other species of the genus *Miana*. Of course in naming merely from larvæ, and still more from description, there are difficulties in specific identification, but from the considerations most obligingly sent me, I just give the remark by Mr. J. Gardner,—“From date and size of larvæ, most probably that of *Miana strigilis* or *fasciuncula*”; and that by Mr. John Robson,—“Leaving all other considerations, and

taking date, size of larva, and habit, I would be inclined to say *M. strigilis*."

One great difficulty is,—how came the caterpillars to be in young Wheat in February? Supposing the eggs to be laid in the preceding year in due course before the autumn Wheat was even sown, there was no likelihood of egg-deposit on the Wheat. But turning to Mr. Renyard's observation of the attack not being at all found on ground sowed after fallow, only "on the lay ground," and this difference being in the same field, the idea occurs whether the *Miana* eggs might not have been deposited on some food grass, and the caterpillars afterwards transferred themselves when food was needed in the spring to the young Wheat. I find on reference to the observations given in Mr. W. Buckler's work on 'Larvæ of British Butterflies and Moths,' vol. v. p. 104, previously referred to, that the larva of *M. exopolita* has been recorded as being about five-sixteenths of an inch long about the end of October, and (after hybernation), about the end of April, as being nearly half an inch long; and it was noticed by Mr. Gardner that in the case of the *Carex*, one of its food-plants, "the habit of the larva is to eat out the very heart of the plant, working its way down to the white portion close to the root"; also that "when one plant has yielded its nourishment, the larva migrates to another."

So far as I could judge from the young Wheat plants sent me, the caterpillar left the centre when the food supply had been exhausted, and it might thus have transferred itself previously. But the destruction was so complete that the Wheat crop failed, and the ground was occupied by another crop, so that I was unable to procure chrysalids or moths.

It seems, however, worth while to give as much information as could be made out of this attack which proved locally so very injurious, and I have given the above notes in the hope that if the attack should recur, or lepidopterists conversant with the appearance of the moths of the genus *Miana* should be working in the coming year in the neighbourhood of Lymington, we might gain observations which, with those above noted, would make a complete record. And meanwhile I have merely given the specific name *exopolita* at heading, bracketed and with note of interrogation, just to show that this was the species which the specimens sent me appeared to resemble.

OBSERVATION.—During the past season nearly all of the insect pests commonly infesting corn crops were more or less reported, as well as some of those more especially infesting grass-land. These I attended to at the time by careful reply to the enquiries regarding nature and treatment; but as all these various infestations have been fully gone

into in many of my previous Reports, with description and figure, and life-history, and habits of the insects, and also information up to date of the best known means of prevention and remedy, it does not seem desirable to enter on these attacks again here, excepting where some new point of serviceableness in some way or other has been brought forward.

Therefore I only give the following short notes of some of our common corn and grass attacks to preserve the record of their presence, referring the reader to my previous Reports for figures and descriptions, and in the case of Daddy Longlegs and Wireworm also to my leaflets, which I shall be happy to forward gratuitously to any applicant.

Amongst the regular corn pests recorded during the past season, we had, as usual, the *Chlorops* or Gout Fly attack in Barley; the Wheat-bulb Maggot of the *Hylemyia coarctata* was also present, and so was Frit Fly (*Oscinis frit*), of which respectively one observer noted that "the Wheat-bulb Fly has not done so much mischief here as in former years, nor has Frit Fly been guilty of any real mischief, the frequent rains causing Oats to spread or tiller so as to fill up all vacant spots."—(D. D. Gibb.) Tulip-root in Oats, of which some well-marked specimens were sent me, will be found noticed under observations of *Tylenchus devastatrix*, the Eelworm which causes the malformation, and of *Heterodera Schachtii*, another kind of Eelworm which, though we have not yet found it at Oat roots, is in England, and has now been recorded as found at Oat as near us as Holland.

No reports at all were sent me of damage from maggot of the Corn Sawfly, the *Cephus pygmaeus*, which in some years does great mischief by feeding within corn stems, so as to injure the yield, and finally gnawing them nearly through in a ring about ground-level, so that at the first wind the stems fall. It does not seem too much to hope that the preventive measures for recurrence of this attack being very practicable, and having been repeatedly given, they may have been the means of lessening amount of presence of this infestation.

Of insect attacks affecting the ears of corn crops, alluding more especially to the corn Aphides, or Plant Lice, and Red Maggot, there did not appear to be any, noticeably destructive, over large areas; but in the case of the little Corn Thrips, the *Thrips cerealium* of Haliday, which has a great capacity for injuring grain in the ear, though it was not reported, I had reason to think, from my own observations, and some made at my request, that it was more present than was generally known of.*

* With regard to this attack, as I have the advantage of being in communication with Prof. J. Jablonowski, Assistant Entomologist at the Experimental

Of pests more especially infesting grass-land, Daddy Longlegs were very troublesome in some districts; the (so-called) Rose Chafer, which does mischief in beetle state to leafage, but is at times exceedingly destructive in maggot state at the roots of grass in park or meadow land, reappeared injuriously in some of the localities in the S.E. of England where its ravages had been serious in 1893.

Amongst communications from various quarters on the subject of Wireworm, some correspondence passed between Mr. B. H. Gosselin-Lefebure, of Blanchelande, Guernsey, and myself as to the effect of paraffin oil on the "worms." From Mr. Lefebure's observations it will be seen that though all the Wireworms experimented on eventually died, yet, to use his own words, they "were very hard to kill"; and it may certainly be conjectured that if Wireworm can stand soaking in paraffin oil for four and forty hours with only some proportion of these larvæ being killed in the time named, and others surviving for some days, paraffin mixtures cannot be wholly trusted to as remedial agents in field use, though they may act well sometimes as deterrents.

Mr. Gosselin-Lefebure sent me the tabulated details of his experiments, of which the following is a short statement of results. On the 6th of August he took about two and twenty Wireworms, some of which he put in pure paraffin oil, in which they sank to the bottom; others he placed in paraffin oil and water (20 parts to 1), in which the "worms" floated on the water beneath the paraffin; and five small specimens he placed in a shallow layer of paraffin, so that the air might have some access to them. Each of the collections of Wireworms were left, placed as above mentioned, for forty-four hours, and were then taken out, passed through water, and then put in boxes with fine sifted soil, but with no (apparent) food in it, and their condition examined at intervals.

The five small Wireworms were found in a few hours to be dead; but of the others a few were moving on the 8th, the day on which they were taken out of the paraffin, and on the following day; hardly any showed motion on the next day; only one of each of the two collections moved on the 11th, and on the 12th all were dead. In an experiment tried by Mr. Lefebure a short time previously, the Wireworms were put in shallow paraffin, and some were alive after several days.

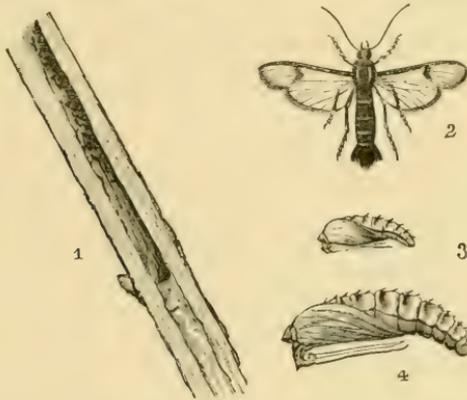
These experiments appear to me to be worth recording as showing

Station of the Department of Agriculture of the Hungarian Government at Budapest, who is especially investigating the order of Thrips (scientifically known as Thysanoptera), and has been good enough to promise to allow me to make use of some of his information when his investigations are complete, I have postponed any remarks of my own for the present.

the possibility of Wireworms being wholly immersed in paraffin for many hours without being either poisoned by the internal action, or stifled by their air-pores being closed during the period, and thus pointing to the success of paraffin applications in field work being merely as deterrents to Wireworm presence.

CURRANT.

Currant Clearwing Moth. *Sesia tipuliformis*,* Linn.



SESIA TIPULIFORMIS; chrysalis, nat. size and magnified; and section of portion of tunnelled shoot.

One of the earliest enquiries regarding insect attacks which was sent me during the past year, was forwarded on the 9th of January from a large nursery gardening firm † in the south of Scotland, relatively to what turned out to be a bad attack of caterpillars of the Currant Clearwing Moth, in the pith of shoots of the Black Currant, an infestation which is ruinous to the shoots above the point of attack, as the caterpillars clear out the centre of the shoot completely for many inches.

This Currant borer has long been known as a trouble to fruit-growers, both in this country and on the Continent of Europe, and is amongst the injurious insects which have been carried to America, but I have rarely had it reported as seriously destructive.

* Synonyms—*Egeria tipuliformis*, also *Trochilium tipuliforme*.

† My correspondents were proceeding to have all the lot of infested bushes, which they had received from one gardener, cleared out and got rid of, but nevertheless, for obvious reasons, I do not give their names.—ED.

The best account that I know of for practical purposes is given by Prof. W. Saunders in his most serviceable volume on American fruit attacks.* In this he states that "the female lays her eggs singly near the buds, where in a few days they hatch into small larvæ, which eat their way to the centre of the stem, where they burrow up and down, feeding on the pith all through the summer, enlarging the channel as they grow older, until at last they have formed a hollow several inches in length." . . . "Before changing to a chrysalis, a passage is eaten nearly through the stem, leaving merely the thin outer skin unbroken, thus preparing the way for the escape of the moth. Within this cavity the larva changes to a chrysalis." . . . "Early in June the chrysalis wriggles itself forward, and, pushing against the thin skin covering its place of retreat, ruptures it, and then partly thrusts itself out of the opening, when in a short time the moth bursts its prison-house and escapes, soon depositing eggs, from which larvæ are hatched which carry on the work of destruction."—(W. S.)

The above extract gives the life-history as shortly and plainly as it can be put,† and my own observations from the specimens sent me agreed well with it.

On the 9th of January my correspondents, writing from the south of Scotland, mentioned:—"When some of our men last week were taking cuttings of Black Currants, they found many of the stems completely eaten out by a certain larva, a specimen of which we enclose." The writers further mentioned that, as they were unacquainted with the pest, they much desired information on this head, and means of prevention and remedy. With this letter, specimens of caterpillars and injured shoots were sent showing the attack to be of the *Sesia tipuliformis*, variously known as the Currant Clearwing, Currant Hawk Moth, or Currant Borer, and a few days later a large supply of infested shoots were sent for examination.

On slitting these longitudinally, I found the pith or centre eaten away for as much as five or over five and a quarter inches in length, from where it had been cut across, this consequently only giving a portion of the length of the larval burrow. As in some cases the

* See 'Insects Injurious to Fruits,' pp. 336, 337, by W. Saunders, F.R.S.C., &c. Philadelphia, U. S. A.; and 16, Southampton Street, Strand, London, W.C.

† The only point of difference between the habits of the larvæ in the description above given and those recorded in Europe, is continuance of feeding. Taschenberg, in his 'Praktische Insektenkunde,' notes the larva as feeding from "July or August until March of the following year." This probably depends much on difference of weather and climate, and I could not have said with any certainty that, though some of my larvæ were partially webbed round, they had ceased feeding, more especially as they were not all full-grown.

upper, and in some the lower part of the severed shoot was missing, I could not tell precisely how long the entire tunnel might have been, but it was very neatly and thoroughly cleared out, stopping abruptly at either end, as figured from life, p. 43. In this tunnel I found the larva lying, apparently hibernating, in several instances enveloped in a more or less perfectly spun covering. In one instance it was lying in a fairly firm opaque coating of dirty coloured web, with a deal of dark-brown frass at one end where the grub was lying, and some at the other end. In another instance it was lying in what had been its roughly spun opaque covering, until it was torn open in slitting the shoot; and in another I found the grub lying with some rubbish or frass on one side, and a little web and frass at the other end.

The larva or grub was hardly half an inch long, pale or yellowish, sixteen-footed (that is, with three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair beneath the tail), the head palish chestnut, the jaws darker, and some chestnut marking on the segment next the head, and also above the tail. These larvae were presumably not quite full-grown, as the full length is given by Buckler at three-quarters of an inch, and either from this, or from the conditions of hibernation, the colour of my specimens, examined in January, was rather lighter in the head and back of the following segment than the brownish tint mentioned both by Saunders and Buckton.

As some writers have expressed doubt as to the method of entrance of the caterpillar into the Currant-shoot, I examined very carefully, and found no reason to doubt that the entrance was made at a bud, and that the maggot worked its tunnel above and below this point. The ends of the tunnel appeared (as a regular thing) to stop abruptly without any entrance hole, and without difference in width of tunnelling, which might be expected to be the case if the larva entered when recently hatched and worked its way onward from one end. In regard to this point my correspondents wrote, "We have examined the shoots again, and the hole seems in every case to have been in the bud." My specimens developed by the chrysalis pushing through the aperture left for its egress, as on June 20th I found two pupa-cases fallen down, and another still attached to the Currant-stem. Figures of one of these are given, life size and magnified, at p. 43.

The little moth is scarcely more than an inch in the spread of the front wings; the body and fore body black with some narrow yellow lines; the wings are transparent, whence the name of "Clearwing," and bordered with black, the fore wings having also a black bar across, and the tip yellowish with black veins (see figure, p. 43). The moths appear in June.

This infestation is to be found in Red and White Currant-shoots, as well as those of Black Currant, in which last all the specimens sent me in the past season were found. It is also said to be found in Gooseberry-shoots; and Kaltenbach, in his 'Pflanzenfeinde,' notes that, according to O. Wilde, the attack is likewise to be found in the long shoots of Nut ("Corylus-ruthen").

Besides the Scottish specimens, samples were also sent me on the part of Mr. Pye, of Knight's Place, Rochester, who mentioned that "Our men have found a great many large maggots this year when cutting the Black Currants. . . ." It was mentioned also that they had not observed the attack in Black Currants before.

Judging by the appearance of the shoots sent me most of them were growths of the previous year, but in some instances they were older.

PREVENTION AND REMEDIES.—In one of the letters regarding the infested Black Currants from my Scottish correspondents, they made the following observation as to origin of the attack in their grounds:—"They are a lot bought from a market gardener as rooted cuttings two years ago, and they must have been in his bushes before he struck them. We have decided to clear them all off and be done with them, as we would not keep such about the place." Where this treatment can be carried out, it is the best plan. But where old-standing bushes are attacked it is not so clear what is to be done, as there is difficulty in knowing from mere outside examination whether the infestation is present. It is said by some that the tunnelled shoots are so much weakened that they are liable to break off, but though this may very likely happen after they are dead, and toughness and pliability have dried out of them, it may be doubted whether it would be so until the maggot had gone from them. The unhealthiness of the leafage would be a surer guide, as the caterpillar, or rather the chrysalis, not developing as a regular thing until June, there would be good opportunity to look into the matter at leisure, and cut off and burn all shoots that were found to be infested.

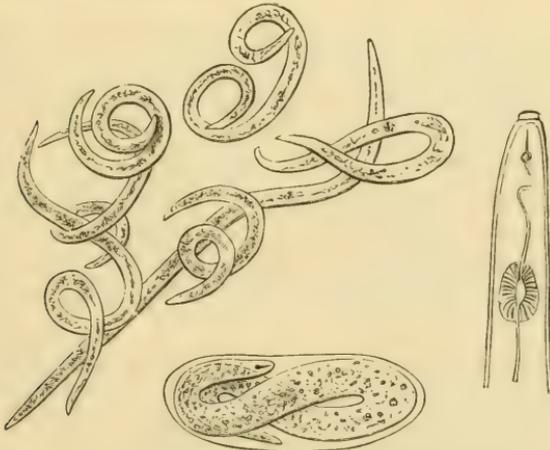
My Scotch correspondents mentioned: "The maggot is almost always found in strong stems, and cannot be detected without cutting the stem, as to all outward appearance at present the bush looks healthy."

On the large scale of nursery gardening the operation of taking cuttings would show fairly where attack was present, and in every case where a severed stem was found to be perforated, the lower part of the shoot should also be cleared off to beneath the bottom of the grub-tunnel and burnt (as well as the upper part). The grub might be in either bit, and if left and merely thrown aside in the shoots, might

very likely go through its changes to moth state and cause new mischief. It has been advised to cut off all ends of old shoots which show a perforation, but in the light of later observations it does not seem likely that these stumps should be used for egg-laying, as the larva would not be supplied with soft pith for food, nor would it be able to form its tunnel up and down in the customary manner. It has also been suggested (where the moths are numerous) that they may be captured and destroyed in the cool of the morning when sluggish; but for ordinary purposes the most practicable method of prevention appears to be (so far as is possible) destroying the tunnelled shoots, and where attack was very prevalent, it might be found that a manager, or some one interested, would learn by glancing along the shoots to distinguish by the condition of the bud, near which the entrance hole had been made, or possibly by the perforation itself being observable, which were the maggot-infested shoots.

EELWORMS.

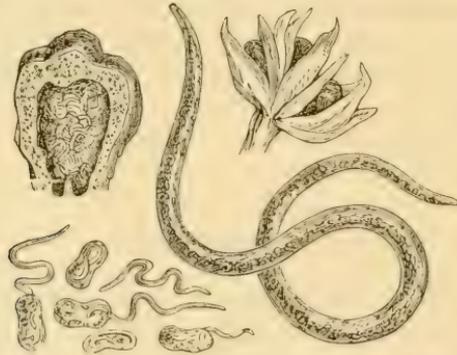
“**Ear-cockle**” Eelworm. *Tylenchus tritici*, Bastian; *Vibrio tritici*, Bauer. **Stem Eelworm.** *Tylenchus devastatrix*, Kuhn. **Root-knot Eelworm.** *Anguillula radiculicola*; = *Heterodera radiculicola*, Greef.; *Heterodera radiculicola*, Müller. **Beet Eelworm.** *Heterodera schachtii*, Schmidt.



Stem Eelworm (*Tylenchus devastatrix*); anterior portion of female showing mouth-spear; and embryo in egg; all greatly magnified (anterior portion mag. 440 times). From figures by Dr. J. Ritzema Bos.*

* The above wood engraving is merely given to save reference as to general appearance. For highly magnified figures of male and female *Tylenchus devastatrix*, together with figure of eggs and other details, the reader is referred to plate accompanying of highly magnified figures given by permission of Dr. J. Ritzema Bos.

Eelworm attack of various kinds has long been present here, as shown by the various forms of distorted growth, of which the cause is now known, and on the Continent the kinds which are ordinarily most hurtful to crop growth have been thoroughly studied to our great benefit; but in this country, I believe that it is only during the last eight or ten years that anything has been worked out of reliable and practicable use regarding the infestations of the Nematode, or Threadworms, commonly known as Eelworms, which seriously infest some of our field and garden crops,—excepting in the case of the Wheat-ear attack, variously known as “Ear-cockles,” Purples, or False Ergot, scientifically as *Vibrio tritici* of Bauer, *Tylenchus tritici* of Bastian.



TYLENCHUS TRITICI.—Wormlets escaping from eggs; section of Cockle-gall with wormlets within, after Bauer's figures, much magnified. Spikelet of Wheat with galls, magnified; wormlet greatly magnified. Natural length of largest about one-quarter inch.

In this case, as the injury is in full sight in the ears, consequently on the diseased growth showing as if small purple or dark-coloured peppercorns had taken the place of the wanting Wheat-grains, there is no fear of its presence being overlooked. Also, as the Eelworms are of such a size that they can be distinguished without very powerful magnifiers, and are massed together in such quantity in the purplish galls, or distorted growth, that on cutting one of these through in a drop of water on a microscope slide they may be seen flowing over in vast numbers, this attack has been a favourite one for popular investigation.

As has been often reported, and the plan most advised for prevention is using the common sulphate of copper steep to seed corn which may have the “Cockle” galls mixed up with it; the method of application being to let the liquid rise above the surface of the corn, and the corn to be stirred gently, so that the “Cockles” may float to the top, and be skimmed off and destroyed. In this double way the infested seed may be expected to be very fairly purified. The above figure is merely given just for comparison of the diseased corn grain growth with those caused to stem and root growth by Eelworm presence.

These Cockle-galls are easily observable; but with regard to the Eelworms which have to be searched for scattered in infested stems or roots, or in the earth round the rootlets, the case is different, and a very large proportion of us have to judge whether they are at work by the peculiar distortions of growth or formation of galls given rise to by the infestation. Also when we have captured the Nematodes and got them fairly on to the microscope slide, there are similarities which make certain identification sometimes so very difficult, that possibly it may be of more use to give notes of the Eelworm infestations mentioned at the heading with their distinguishing characteristics together (for convenience of comparison), rather than to disperse them under the headings of the names of the crops which they may have been more especially attacking.

Firstly, just to note the main distinctions of the three most important kinds of Eelworm noted at heading, the Stem Eelworm, *Tylenchus devastatrix*, which we know best as causing "Tulip-root" in Oat plants, and "Stem-sickness" in Clover, is *always* eel-shaped; reference to the figures at p. 47, and in the plate, will show that the little eel-like form is to be seen in the egg, and in the young or larval state it is also eel-like, and so are the males and females.

With the "Root-knot" Eelworm, "*Heterodera radicola*," which does injury most especially by causing gall-growths at the roots of various plants, the development is different. The young Eelworm may be seen (see fig., p. 61) in eel-like shape in the egg, and it hatches out like a little eel, and after wandering for a time forms a kind of cyst, from which *the male* comes out in eel-like shape. But it is not so with the female. In her case the body swells up into a gourd-like or pear-shape, and gradually becomes filled with eggs and young larvæ. As yet this species of Eelworm, though present on the Continent, and very injurious in America, is little known in this country, excepting as damaging some kinds of crops under glass, and especially Tomatoes and Cucumbers, by causing gall-growth at the roots.

The Beet Eelworm, *Heterodera schachtii*, is very like the Root-knot Eelworm; it is eel-shaped both in larval and developed male condition, and the female is not eel-shaped but swelled, but it differs from the female of *H. radicola* (the Root-knot Eelworm) in being citron- or lemon-shaped (see fig., p. 56); the habits of these two species differ in this respect, that though both of the kinds are to be found in the roots, and in the earth round the roots of the plants which they infest, yet the Beet Eelworm does not apparently cause gall-growth. This kind of Eelworm is especially injurious to Beet on the Continent of Europe, and, as will be seen further on, has been observed in the past season at one locality in England at the roots of Hops.

The distinctions above mentioned, namely, that the females of the

two species of *Heterodera* are not eel-shaped, are very important to be borne in mind, and those who have to depend on others for identification would do well to ask to have this point well examined into, otherwise mistakes, which are very important practically, sometimes occur, and loss and disappointment is likely to arise from want of the proper treatment.

The *Tylenchus devastatrix*, or "Stem Eelworm," is the kind which as yet has been most commonly observed in this country; but as the observations of the past few years have shown that the *Heterodera radiciola* is also present in the country, and the observations of 1894 have brought to light some degree of presence of *H. schachtii*, I give accompanying a Plate with magnified figures of the *T. devastatrix*, drawn from life by Dr. J. Ritzema Bos* (which he is good enough to permit me to make use of). This gives, with the accompanying explanation from same work (see note), all requisite details for microscopic identification, and will be of service in showing what are the distinctions between this species of *Tylenchus* in all its stages, and the two species of *Heterodera* above-named, which, in their larval and male conditions, bear some resemblance to it.

EXPLANATION OF PLATE.

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

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

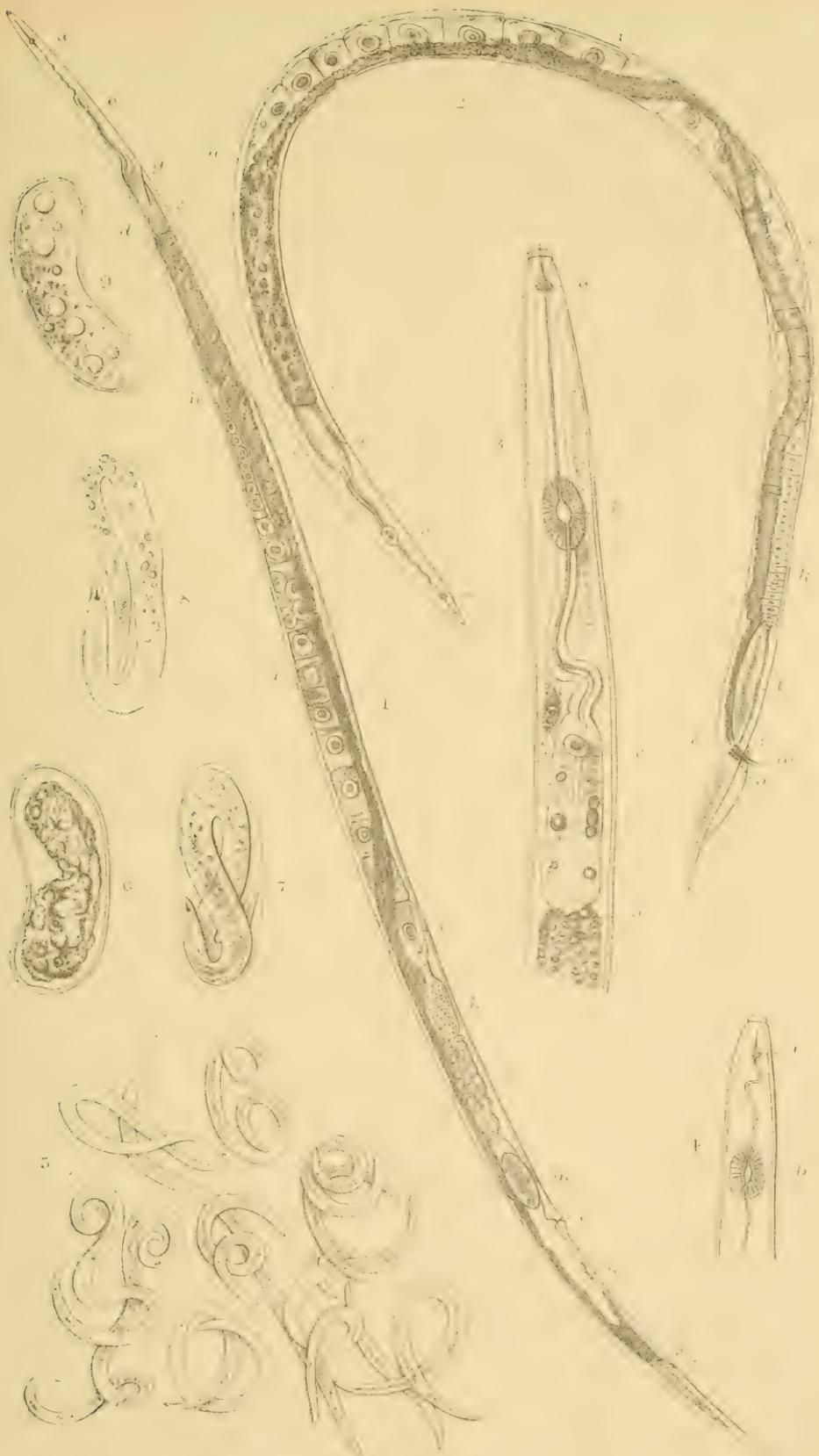
FIG. 2. *Tylenchus devastatrix*, male, taken from an Onion-plant; magnified 200 times.

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

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

For *a*, *b*, *c*, and *d*, see explanation of fig. 1. In front of the spear (*a*) is shown the labial region, and lower, at the base of the spear, the *musculi protractorii* leading forwards, and the *musculi retractorii* leading backwards. The half of the œsophagus in advance of the first bulb, or muscular swelling (*b*), has a straight direction; the

* See Plates I. and II. in 'L'Anguillule de la tige (*Tylenchus devastatrix*, Kuhn),' par Dr. J. Ritzema Bos, Prof. à l'Institut de l'État à Wageningen. Haarlem, 1888.



D^rJ. Ritzema Bos ad nat. del.

West Newman lith.

Tylenchus devastatrix Kuhn.

half which extends from the first to the second muscular swelling is waved. In the second bulb nuclei are visible. Near (*d*) the intestine begins; in the wall of this the separate cells are not distinguishable, because of the presence of the numerous drops, which refract the light strongly.

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

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

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

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

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

The above figures are all enormously magnified; exact amount is given above of enlargement of figs. 1, 2, 3, and 4, and amount of enlargement of figs. 6, 7, and 9 may be estimated by comparison of size of fertilized egg shown at *m* within female *Tylenchus*, fig. 1.

With regard to dimensions of this species of Eelworm,—these have previously been given; but during the autumn of last year (1894), in the course of some investigations regarding a curious observation of this species found in a locality in Kent (see p. 52), Dr. Ritzema Bos was good enough to place in my hands a list (from his own personal researches) of maximum and minimum length of males and females of *Tylenchus devastatrix* in various of the plants which they ordinarily infest, together with the following note of result of measurement:—

“Upon an average, the *Tylenchus devastatrix* was—in *Secale*, 1·19 mill. (males), and 1·26 (females); in *Hyacinthus*, 1·43 mill. (males), and 1·26 (females); in *Allium*, 1·57 mill. (males), and 1·54 (females). Those in Oats, Clover, and other plants also varied between 1·18 and 1·60 mill. in length.”*

Turning now to the practical side of “Stem Eelworm” infestation. Besides its presence in Rye, Hyacinth, and Onion-bulbs, as above-mentioned, in which it occurs especially on the Continent of Europe, we have it here only too commonly in various kinds of plants, and causing various forms of diseased growth, as that like miniature Pine-apple tops in Carnation-shoots, thence called the “Pine-apple” disease, and the stunting and distortion of the plant and pods of field Beans which is occasionally met with.† But the best known

* As trustworthy identification of this and other species of Eelworms depends on the correctness of excessively minute microscopic powers, and not only much knowledge, but much experience of the observer, I have never yet myself given any definite opinion for publication as to species of Nematoid worms without submitting my identification to the verification of an expert, and almost always to the excellent knowledge of Dr. J. Ritzema Bos.—ED.

† For figure of this from life, with description of attack, see my ‘14th Annual Report on Injurious Insects,’ pp. 17—21.

forms of attack, unfortunately never failing to be reported yearly, are those causing the diseased growths known as Tulip-root, or as Segging in Oat-plants, and Stem-sickness in Clover.

During the past season of 1894, I have had various applications regarding the above infestations, and in the case of Tulip-root, or Segging, some exceedingly well-marked specimens were sent me; but as quite full descriptions of these attacks, with well-proved means of prevention and remedy, have previously been given in these Reports, I have only entered on the subject again as possibly useful in connection with a very curious observation made last summer at one locality in Kent of the presence of this Eelworm (or as far as appears at present this Eelworm), being found as well as the Beet Eelworm, *Heterodera schachtii*, at Hop-roots in coincidence with the diseased growth of top and leafage known as being "nettle-headed."

That the *H. schachtii*, the so-called Beet Eelworm, should be found at Hop-roots is not surprising, for it infests various plants, and from observations made in Holland during the last few years evidently it is either spreading more widely, or its presence is more observed. But the presence of the *Tylenchus devastatrix* in the root or root-like underground part of the Hops is a very remarkable and curious circumstance, as previously it does not appear to have been observed save in stems or portion of stem-growth.

The first notice which I observed of this investigation was in a paragraph (subjoined in the accompanying note) which was given in the number of 'The Loudon Corn Circular' for September 3rd (1894), as a quotation from 'Natural Science' for that month. It is perhaps desirable to give this *verbatim* and *in extenso*, as showing the locality and basis of the observations.*

* "HOP DISEASE IN KENT.—We learn from Professor J. Percival, of the South-Eastern Agricultural College, Wye, Kent, that he is at present engaged investigating the disease which causes Hops to become what is known as "nettle-headed." The disease is met with in many districts in the county, and has rapidly increased during the last few years—in some cases leading to a complete destruction of considerable areas of Hop-gardens. The early delicate varieties are most attacked, and especially those which have been growing for a considerable time. It is rarely until five years after planting that the disease is seen, and usually not until a much later period. In a typically affected plant the leaves are smaller than is generally the case, and are transformed in such a manner as to become strikingly like those of the Stinging-nettle. The edges of the leaves turn upwards; the fibro-vascular bundles in them are increased slightly in thickness, and stand out well from the under surface of the leaf. Closer examination shows destruction of the soft tissue in immediate contact with the fibro-vascular bundles; the parts become thin and yellow, and much resemble the thin spots produced by the action of sulphur dioxide gas on the leaf. The internodes of the plant are short and the main stem and branches taper more rapidly than in healthy plants. In practically all cases the bine or stem, after climbing a short distance up the pole, loses its power of twining

Being desirous to know more on the subject, I applied to Mr. E. A. White (mentioned below), with whom I had previously been in correspondence on other subjects connected with Hops, who put me in communication with Prof. Percival, with the remark added, "He was the first through myself to discover the troubles, of which there are two in the roots."—(E. A. W.)

On Sept. 9th, Prof. Percival was good enough to write to me that, in reference to the disease known as "nettle-headed" Hops, he had been paying attention to it for some time, and found it was caused by a *Heterodera*, which he considered to be *H. schachtii*, and that along with this Nematode there was almost always to be met with in the thick parts of the roots *Tylenchus devastatrix*. With regard to this species, Prof. Percival mentioned he thought there could be no doubt, also that it had been carefully examined by Dr. De Man, who had also verified his identification of *H. schachtii*. (Dr. De Man being a well-known observer and writer on Nematode-worms, his opinion is very valuable in this interesting investigation.—ED.)

A little later on, Prof. Percival was good enough to send me a little box of Hop-rootlets in earth, which gave me a good supply of the *H. schachtii* in various stages for microscopic examination, some of the citron-shaped females of which I give a figure of magnified (as I observed them, outside the Hop-rootlets) at 4 and 5, p. 56.

With regard to the other kind of Eelworm found present, which appears in all essential points not to differ from our only too common "Stem Eelworm," found in "Tulip-root" disease and "Stem-sick" Clover, namely, the *Tylenchus devastatrix*, Prof. Percival wrote me on Sept. 16th:—"Some Hop-roots were sent to me a day or two ago, and some this morning; the thick parts I am sending herewith contain

and topples over; when not tied up the whole stem becomes slack, slides down its support, and the plant lies in a heap on the ground. So far the experiments which are being carried out on the Beltring estate of Messrs. E. A. White and Co., Paddock Wood, point to the circulation within the plant of a poison which brings about curling of the leaf, stoppage of growth of the fibro-vascular tissue, and loss of turgor of the cells in the leaf near the ribs, with resulting yellow patches there. The leaves on the main stem nearest the ground are affected first, and then follow those at the nodes above in regular succession. The branches in the axils of these show the same regular sequence of diseased leaves, the lower branches being affected first. The cause is undoubtedly connected with the root, and Professor Percival finds in the cortex of many diseased specimens, close up to the bast, considerable numbers of the Nematode *Tylenchus devastatrix*, Kuhn, usually known as an Eelworm. Before any completely satisfactory cause can be established or remedy suggested much work is necessary. At a later date we hope to be able to give an extensive communication from Professor Percival dealing with this interesting and important investigation.—'Natural Science' for Sept.' From 'London Corn Circular,' No. 71, p. 14, 1894.

large numbers of what, I think, is *Tylenchus devastatrix*. This species I find nearly always present in the diseased plants (as well as *Heterodera* in the finer rootlets), but is, so far as I have yet made out, confined to the thicker parts of the root, and in the *cortex* close up to the bast in many instances. Where they were present the root does not grow much in thickness, except very irregularly. I hope you will be able to get a glimpse of this *Tylenchus*. I have forwarded another piece to Dr. Ritzema Bos for identification. This morning I casually found larvæ, eggs, and adults in the root, but this was a chance."—J. P.

In regard to the effect on growth, Prof. Percival remarked that the most characteristic symptoms of the disease were to be found in the leafage, and as I had not the opportunity myself of securing specimens, and he was not at the time in Kent, he was good enough to forward me a few dried leaves showing the peculiar conditions he noted as accompanying attack; with the mention that he had investigated the anatomy of the leaf carefully, and found some interesting points, which he would explain later.

These points, and an account of his observations, are, I believe, to be given by Prof. Percival in the next part of the Journal of the Royal Agricultural Society, to be published on January 1st, 1895; but I was so desirous to include some reference to this interesting observation in my own report of the observations of 1894, that I requested and obtained permission from Prof. Percival to include what he had himself communicated to me in my notes now (November, 1894) preparing for my next Annual Report. For this I feel greatly obliged.

In my own examination of the thick roots placed in my hands by Prof. Percival, I found narrow anguilli-form Eelworms in the white part below the external bast, which certainly greatly resembled the *Tylenchus devastatrix*, but I could not by any means feel certain whether they were of this species, or of the *H. schachtii* in larval or male state, therefore I laid my difficulties and specimens before Dr. Ritzema Bos, and append, with many thanks, a part of his valuable replies, as (with the reference to the figures also given) they may be of great service to other enquirers.

Dr. Ritzema Bos 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*."

Precise maximum and minimum measures of length of male and

ADDENDUM.

ON receipt of Part IV. of the fifth vol. of the Journal of the Royal Agricultural Society for 1894 (published Dec. 31st), I found, to my great regret, that the paper on Hop Eelworms by Prof. Percival was not included, the valuable information contained in it thus not reaching Hop-growers at the earliest possible time.

Therefore, lest I should appear to be playing such a despicable part as without authorization to appropriate skilled discovery, I wrote to Prof. Percival, offering to cancel the sheet on Eelworm in my Report, which thus unfortunately (from unexpected circumstances) precedes his detailed and illustrated paper, of which he has permitted me a sight in the revised proof in the form in which we were looking forward to its publication.

To this Prof. Percival replied to me on Jan. 9th:—"With regard to your own paper on Eelworm in your Report (18th), please do not think of cancelling it. You have my full consent to publish just whatever and whenever you please."

For this I thank him much; it is a great favour; but I think that

under the circumstances I owe it to Prof. Percival, to my scientific and many colleagues, and to myself, to point out that, though from the change above mentioned my short notes unfortunately precede the detailed observations of the discoverer,* yet that I have in my present paper fully acknowledged them to the author ; and I desire to add still a little more. Not only that the observations which I give are from specimens placed in my hands by Prof. Percival, but that it is to himself wholly that we owe this record of the presence of Eelworms at Hop roots ; a discovery of great interest and value, both scientifically and practically, and involving points of such skilled and minute investigation as place the observer in the highest ranks of our own Nematologists, and claim that the credit of his discoveries should be carefully preserved to their author.

E. A. ORMEROD.

February, 1895.

* To be published in 'Natural Science' for March. Macmillan & Co., Bedford Street, Strand, W.C.

female specimens of *T. devastatrix* found by himself in various kinds of plants were placed in my hands by Dr. Ritzema Bos, but as these would not be of service to general investigators, I have not transcribed them in detail, but refer the reader to his averages of these given at p. 51. Proceeding further with his notes of measurement, Dr. Ritzema Bos added:—"Kuhn found in *Dipsacus fullonum*" (the Fuller's Teazle) "*T. devastatrix* varying between 0.94 and 1.162 mill.; in Clover between 1.21 and 1.56 mill. The *Tylenchi* in the Hop-roots had a length of 0.76, 0.74, 0.94, 1.02, and 0.66 mill.

"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.

"It is also very curious that in the diseased Hop-plants should exist both species,—*T. devastatrix* and *H. schachtii*. Though I agree with you that probably the latter will prove to be the real cause of the disease, only infection experiments can decide whether the first or the second Nematode is the real cause. Perhaps one is the cause, and the other increases the effect of the disease."—(J. R. B.)

In regard to identification of the long and narrow (in fact, *eel-shaped*) Eelworms which I found in the white part of the bark beneath the bast, and which I found difficulty in differentiating as to whether they could *certainly* be described as of *T. devastatrix*, or larvæ and males of *H. schachtii*, Dr. Ritzema Bos replied:—"I found also male and larval *Heterodera schachtii* in the roots of the Hop, but more in the little rootlets than in the thicker roots; but there is a clear difference between a *Tylenchus* and a larva or a male of *H. schachtii*, as you can see by comparing the figure," &c., "of my 'Tierische Schädlinge und Nützlinge.'"

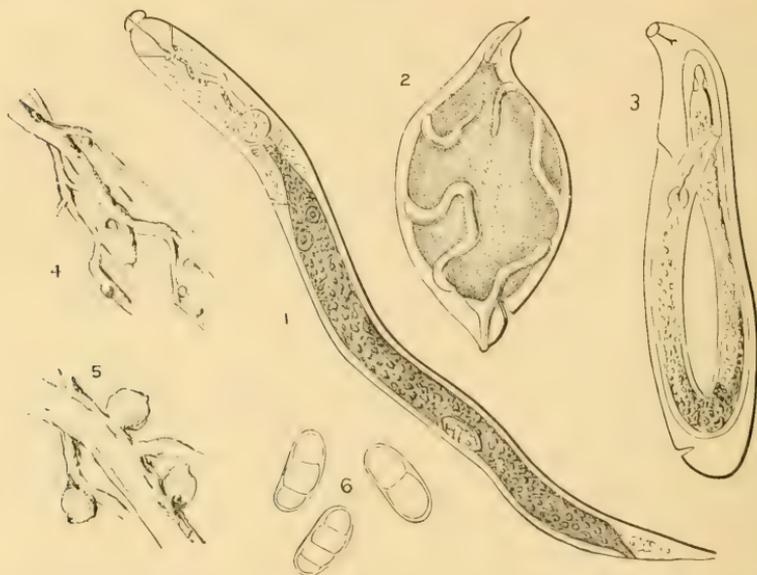
For these figures, given in present Report by kind permission of Dr. Ritzema Bos, the reader is referred to the plate of *Tylenchus devastatrix*, and to the figures of *H. schachtii* at p. 56.

There it will be seen that the tail of the *Tylenchus* ends, as figured on plate at 1 and 2; the tail of the male of *H. schachtii* (see figure of male Eelworm, still encased, p. 56) is rounded at the end, and the spicula are placed near the end of the body; the termination of the tail of larva of *H. schachtii* is also given accompanying in same figure. Further (and see figures), *Tylenchus* has a sucking-stomach and a

digesting-stomach; *H. schachtii*, also in its larval form, only a sucking-stomach.

The above distinctions, which are very clear when placed thus by an expert before only partially qualified observers like myself, may probably assist others in the intricacies of identification of this very involved Nematoid presence.

The above considerations, it will be seen, refer to the presence in the Hop-roots of the Stem Eelworm, the *T. devastatrix*, and distinctions



HETERODERA SCHACHTII.—Newly-hatched larva; male in case; citron-shaped female: all greatly magnified from figures, p. 769 of 'Tierische Schädlinge und Nützlinge,' by Dr. Ritzema Bos. Females at Hop-roots, and eggs, magnified from life by Ed.

between this and the "Beet-root" Eelworm, the *H. schachtii*, in some of the stages in which this last much resembles the former; the following notes refer to the *H. schachtii*, which (though much more likely than not long present here) has not, as far as I am aware, ever been previously recorded as found in England, until observed in the past season by Prof. Percival.

The Eelworm which we now know as the *Heterodera schachtii* was discovered by Schacht at the roots of young Beet-plants in 1859, and later on (in 1871) this species was described and named by Schmidt after its original observer. From being first observed (and also from its prevalence) at Beet-roots, it has received the name of Beet Eelworm; but it is to be found at the roots of many other kinds of plants, as of Cabbage, Mustard, and some other cruciferous plants, including the Wild Charlock; Mangolds as well as the Sugar Beet;

Oats as well as Couch-grass, and various other plants wild and cultivated.

The female is citron-shaped (see figures), and may vary from 0·8 to 1·3 millimetres, that is, may be slightly more than one-twenty-fifth of an inch in length; at one of the projecting, or somewhat pointed, ends is the mouth-opening containing the "mouth-spear," near the other is the reproductive opening, and after breaking out from beneath the slight swelling of the bark where her larval life has been passed, the female is to be found attached to the roots and rootlets.

The colour varies with age from yellowish-white to a much deeper tint; the fully-developed specimens I have seen at the Hop-rootlets were of a medium chestnut. The female contains up to as many as 350 eggs, about 0·08 mill. long by 0·04 mill. broad, and somewhat bean- or kidney-shaped. These contain an eel-shaped embryo, and most of them remain in the swelled body of the mother until the wormlets have developed from them. The intestines meanwhile, and other internal organs of the female, degenerate, she becomes a mere husk and dies, and the larvæ, after quitting their eggs, leave the body of the dead mother through the generative opening.

The larva in this early stage is in eel-like form, and it moves through the earth until it finds a root suitable for its attack. This it pierces into with the help of its mouth-spear, and establishes itself, and feeds within; and as it has been observed that many of these wormlets commonly attack the same root, they set on foot corresponding amount of mischief.

Here the larva goes through its changes: it sheds its old skin, assumes a thicker form, ceases to move, and gradually from its presence beneath the outer skin of the root causes this to bulge out like a small swelling. The distinction between the sexes now soon makes its appearance.

A thick motionless larva destined to become a male temporarily ceases to feed, shrinks within its old skin, develops a thin new one, and becomes a long eel-like worm, which gradually grows into an adult male. The figure (p. 56) shows the male still cased in the thin skin and as it lies under the outer coat of the root in the little swelling above-mentioned (in the Beet-roots, or rootlets, from which the observations now quoted were taken). When developed, it bores its way out of its old skin, and out through the coat of the root into the soil, and finds and fertilizes the female.

The development of the female is by gradually growing and distending until she entirely loses all worm-like or eel-like shape, and becomes successively flask-shaped, then of an elongated oval form, then lemon- or citron-shaped without,—and within develops the female organs,—and then rupturing the swelled root coat, remains, in regular

course of things, attached where she burst through the root. The entire development from egg to sexual maturity is stated to take four or five weeks, and there may be six or seven successive generations.

The above abstract is mainly taken from the account by Dr. Ritzema Bos referred to below.*

Continuing now from such few observations as I was myself able to make. The specimens which Prof. Percival was good enough to forward enabled me to have a good view of the females of *H. schachtii* *in situ* on the Hop-rootlets, as well as of the young larvæ and eggs in different stages of development.

On September 13th, he favoured me with specimens of fibrous Hop-roots with 'smaller and finer side-rootlets, together with the earth in which the roots were growing. Amongst these I found the citron-shaped female adhering. With a two-inch focus magnifier, the Nematode was distinguishable as a minute globular body, much the same colour as the Hop-roots. With a higher (an inch) power, the characteristic shape of the fully-developed female was observable, that is, the somewhat spherical or globular shape prolonged at each end, and on pressing this, it cracked, and great numbers of eggs burst out; about a hundred could be counted with a quarter-inch glass, and probably there were many more. Other females of various size besides the fully-developed chestnut-coloured specimens were present, some of them still young and white and smaller, and in one instance, where the creature was still flask-shaped, the contents were only partially advanced to egg-form.

In the case of one specimen, for which I secured a very good light, the bright chestnut surface appeared to be pitted with very minute punctures, and in this instance I had the opportunity of watching the exit or expulsion of the young wormlets, with some eggs accompanying, almost in the natural manner from the reproductive opening of what had been the female, but now little more than the protecting husk. This was a somewhat circular orifice, situated on one side of the

* Those who desire to go into the life-history of this Eelworm practically considered for agricultural purposes, as well as for technical scientific study, will find it very serviceably given, with quotations and references to the works of Strubell, Kuhn, and other special observers, in the 'Tierische Schädlinge und Nützlinge' of Dr. J. Ritzema Bos, pp. 765—777, Berlin, 1891. For popular English use, a short abstract of the above will be found in 'Agricultural Zoology,' an abridged form of the above work translated by J. R. Ainsworth Davis, Prof. of Biology, &c., in the University College of Wales, pp. 226—230: Chapman & Hall, London, 1894. I have not given a list in full of the many and valuable publications on this subject, or bearing on this subject, by such distinguished writers as Drs. Kuhn, Strubell, Voigt, &c., as these publications would not be very serviceable for the practical home agricultural work for which these Reports are chiefly intended; but to those who wish it, I believe I may say I could give the requisite titles.

Nematode just above the lower extremity, and was slightly more in the transverse length,—that is, across the wormlet,—than in the vertical measurement. The edge of the opening was not at all torn, but very finely corrugated, and on very gently pressing the Nematode in glycerine beneath a thin glass covering, a number of minute eel-shaped wormlets at once began to appear, with eggs mixed with them. These at first merely pressed forward, or were expelled from the orifice, but presently the female (or perhaps at this stage what might be known by the name sometimes used of the egg-sack) cracked, so that the rest of the contents merely dispersed irregularly.

The eggs, which were plentiful in various of the females, were of the shape figured (magnified) from life (see p. 56), that is, somewhat bean-shaped, though the convex and concave curve was very slight; the gradual development of the larva within was easily observable. It will be noticed that the eggs figured (which at first were single cells enclosed within the egg membrane) show at 6 the beginning of segmentation, on the progress of which such profound considerations of methods of growth were laid down by Strubell, that it may be of interest just to allude to them.*

In the course of my examination, I noticed many cases of injury to the outer skin of the Hop-rootlet, which presumably showed that a deal of mischief had been going on, first by the wormlets feeding within, and then by damage to the cuticle in the course of their boring or bursting out; but I only saw two instances of what appeared to be the swelling of the outer root-bark remaining still unbroken by the developing Nematode within.

It is quite plain that damage to the health of a plant attacked in this manner is likely to occur. We have examples of this in the effect of this Eelworm root-infestation to Beet, which is thus described:—"The leaves get weak and limp, and the outer ones especially get yellow, spotted, and die off. Later on the inner leaves die as well, after which the top of the Beet becomes black, and the whole root gradually decays. In less severe cases the Beet may recover towards autumn, and develop new heart-leaves, but the crop remains small," &c.† We know of it also as injurious at roots of other plants.

But how far this infestation *as a regular thing* may be connected with "nettle-top" in Hops, is a matter we need more information about.

Looking over the letters of various Hop-growers who have been good enough to write in answer to my enquiries, such various conditions

* See Strubell's 'Untersuchungen über den Bau und der Entwicklung des Ruben-nematoden *Heterodera schachtii*, Schmidt.' 'Biblioteca Zoologica,' Heft 2, 1888.

† See 'Agricultural Zoology,' by Dr. Ritzema Bos; translated by Prof. J. R. Ainsworth Davis, p. 227. Chapman & Hall, London, 1894.

are mentioned, as neglect, checked flow of sap, grubs working in the hill, &c., as possibly causing nettle-headed growth, that it occurs whether (besides cases where the disease, as observed by Prof. Percival, exists coincidentally with Eelworm presence) this same, or a very similar kind of diseased growth, may be caused by various other attacks or diseases.

Where it is caused, or partially caused, by presence of the "Stem Eelworm" (*T. devastatrix*), it might be hoped that the same kind of applications which prevent or remedy this infestation in, or its effects on growth of, Oats or Clover, might do good. Sulphate of potash, or, better still, sulphate of potash and sulphate of ammonia, which is one of the mixtures that answered well, rapidly, and with well-continued action at Rothamsted* as a remedy for "Stem-sickness" in Clover, might easily be tried. The remedies of employing "lure-plants" to attract the wormlets, and a large number of the applications or treatment used in field cultivation of such crops as Beet or Oats when infested with either of the above-named Eelworms would not be practicable with Hops. But nothing could be more sensible than the plan mentioned by one of my correspondents, namely, where single or a few plants are found infested, to dig them up and destroy them. If these were burnt, there would be an end of the matter so far.

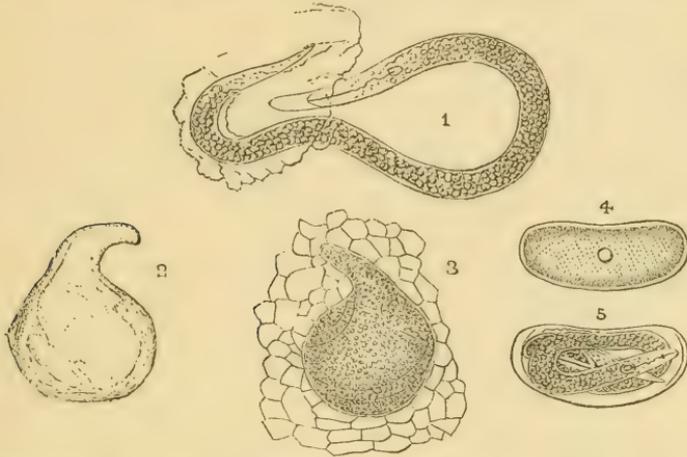
For myself, in placing the subject before my readers, I do it under submission to them, that it seems right just to mention so much as I know as certain, for we may find, now attention is directed to the "Beet Eelworm" being in the country, that it is more present here both at the roots of Mangolds and of Oats than is known of, and also (with thanks to Prof. Percival for placing specimens in my hands) I wish to draw attention to his forthcoming account of his interesting observations, which may be hoped will throw some light on the attack as studied by him in its Kentish locality.

Root-knot Eelworm. — Just a few words should be added with regard to the "Root-knot" Eelworm, the *Heterodera radicola*, figured at p. 61. This Nematode greatly resembles the *H. schachtii*. It is eel-shaped in larval and male condition, and the females are very like those of the *schachtii* in becoming inflated in figure, but when fully developed they appear (see figure) to be pear-, or gourd-, or tulip-bulb-shape, that is, somewhat pointed above, and flattish or slightly concave below, rather than like the *schachtii*—lemon- or citron-shaped, that is, somewhat spherical, with a prolongation at each end.

Their method of injury is similar in many respects, but also partially differs in the "Root-knot" Eelworm (as its name imports) characteristically causing gall-growths on the roots of the infested plants until, in the case of the Tomato and Cucumber roots (on which

* 'Manual of Injurious Insects,' by E. A. Ormerod, p. 54.

it troubles us most in this country), the infested gall-growths may be found from a quarter of an inch over, to masses of confluent galls from one to two, or three and a half inches in length, and about half an inch in breadth. On a single plant as many as twenty of the main roots may be found galled, and these as they branched and branched



HETERODERA RADICICOLA.—1, larva; 2 and 3, females; 4 and 5, eggs in different stages of development: all enormously magnified. (2) from sketch by Ed.; the other figures after Prof. Geo. Atkinson.

again, and even the small side-fibres, were to be found loaded with the irregularly formed soft lumpy galls.

This attack has been entered on in such great detail in my two preceding Reports that it is unnecessary to repeat the observations here, more especially as we seem still in ignorance of any application which can be brought to bear satisfactorily on it as a distinct remedy. As yet we do not know it in this country as a field attack.

Any really practicable measures of prevention and remedy which might be trusted to, to answer at a paying rate are greatly needed, for the reports sent during the past season show this infestation to be very firmly established in various localities as an attack to Tomatoes and Cucumbers under glass, and is a serious cause of loss. This, like the *H. schachtii*, also attacks various out-of-door crops, but we do not as yet appear to have it on them here.

Those who wish to study the history of this Eelworm both practically and with profound scientific detail, and full illustration, will find these, and also very many titles of publications on Nematode life and history, in the works noted below.*

* 'Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode *Heterodera radiculicola* (Greef.), Mull.' Science Contribution from the Agricultural Experimental Station, Auburn, Alabama, U.S.A., 1889. Useful information is also given in 'The Root-knot Disease,' by Dr. J. C. Neal. Government Printing Office, Washington, U.S.A., 1889.

GOOSEBERRY.

Gooseberry and Ivy Red Spider. *Bryobia pratiosa*, C. L. Koch.



BRYOBIA PRÆTIOSA, from life; *B. SPECIOSA* (outline figure after Koch): both magnified. Leaf infested by "Red Spider," nat. size.

The Gooseberry Red Spider was one of the infestations of 1893, of which the prevalence was in marked coincidence with the heat and drought which occurred in England from the beginning of March to the end of June, and very especially from the beginning of March until the middle of May in that year. The first dates of appearance reported were March 15th and 17th.

In the past season, that of 1894, this "Red Spider" attack reappeared like some others to an unusual amount, as relics of the unusual prevalence in the previous year supplying an unusual amount of survivors through the winter, and (like them) after raising some anxiety lest a second visitation was at hand, quietly dropping down into average amount of presence.

In 1894, the first note of observation of Red Spider on Gooseberry-bushes was sent me by Mr. J. Hiam, from Astwood Bank, near Red-ditch, on Feb. 24th, with the mention that he had already found a considerable quantity hatched out, the first having been found on Feb. 4th.

On the 2nd of March Mr. Francis Nixon, of Great Eversden, near Cambridge, to whom I was indebted in the previous season for careful and useful observations of this Gooseberry pest, wrote me as follows:

—“Replying to yours of Feb. 26th, I examined my Gooseberry-bushes at about the same date as your correspondent from the west country, but at that time I was only able to find one or two ‘Red Spiders,’ and I therefore thought the matter scarcely worth mention.

“To-day being fine and bright, I have made a further examination, and I find a few Spiders on the trees which are the most forward (the buds of these are just bursting); they are *very* small indeed, scarcely discernible by the naked eye, and of a bright red colour. I find them on the stems and branches right up from the ground, and I have at once greased the stems of the worst bush I could find, in order that I may prove whether they come up from the ground at this early period. I do not think this can be the case, as the Spiders appear to me to be only just hatched. I may say that there are only a few bushes on which I can find any at present.”

A few days later, that is, on the 5th of March, I received the following communication from Messrs. T. R. Skinner & Son, Covent Garden Market, London, E.C., relatively to the great loss caused by the Red Spider infestation, especially in the preceding year, and the likelihood from the numbers already observable of a serious repetition of the attack. Messrs. Skinner enquired whether I could “suggest any remedy for a serious attack of Red Spider with which both our own and several of our clients’ Gooseberry plantations this year seemed to be threatened. The leaf is just coming out, and already seems to be covered with this great pest. Last year, in consequence of the dry weather, the ravages from this cause were most serious, and nothing seemed to do any good. We tried washing with parafin (of course, a weak solution) and soot, as well as slaked lime, but all to very little purpose, and this year the evil seems to promise an increase. If you could point out a remedy, it would be a great boon to market growers of Gooseberries, to whom this Red Spider the last few years seems to spell almost ruin.”

On the 8th of March, Mr. Nixon, reporting further to me on appearance of Red Spider, mentioned that he had information of bad infestation being already observed although so early in the season, and that if want of rain occurred he apprehended recurrence of bad attack. He remarked:—“If this turns out to be a moderately dry season, it is my opinion we shall have the worst attack that has ever been known. . . . I examined my bushes daily, and it appears to me the number of Spiders gradually increase, and it is evident that they must proceed from the eggs which were laid in the twigs and branches last autumn; . . . they are *very* small, too small to be seen by the naked eye. I cannot find *one* old or full-grown Spider, or anything approaching one, and I have noticed this before at this time of the year.”

Mr. Nixon made some remarks, which are well worth attention, on the importance of taking the spring appearance of Red Spiders in time, so as to destroy them before their season of egg-laying had arrived, and mentioned that if "once egg-laying commences, the Spiders continue to hatch throughout the season, and the infestation is indefinitely maintained, therefore it is absolutely necessary and most important that an early application should be given before egg-laying begins. I am persuaded the great secret of the whole thing lies in this one point. Once the eggs are there, I do not believe it possible to be rid of the pest for that season. You may kill the Spiders by thousands, as I did last year, but still there remain some eggs to hatch and continue the infestation.

"I intend to give my bushes a dressing of 'Anti-pest' as soon as possible, and I have found a much more economical way of doing it than last year, by which, I believe, three-fourths of the stuff will be saved. I shall use two Eclair sprayers on a specially constructed garden-engine made long and narrow, so that it will easily pass up the rows of bushes. The sprayers will both be in use at the same time, doing bushes on each side."

During the season of attack in 1893, Mr. Nixon devoted great care and attention to getting the Red Spider under on his own Gooseberry-grounds at Great Eversden, and the good results of this treatment are showing now as well as then, for he concluded the long letter, of which I have given some part, with the remark, "I may say that in a large proportion of my bushes no Spider has as yet appeared. I find some of my neighbours have it badly."—(F. Nixon.)

With regard to locality of the "Red Spiders" at different times of the day on various parts of the Gooseberry-bushes (which is important relatively to bringing sprays or washes to bear on them), Messrs. Skinner, of Covent Garden, who had previously written to me (see p. 63), remarked on March 19th:—"We notice the Spider congregates in the crevices of the bark, and when the sun is out seems to get on the leaves; towards nightfall, again going back to the wood. Some pieces of the wood are literally painted with them. This is on a plot of about fifteen acres, which has been heavily manured every year. The curious point is that on another piece of about forty acres a very short distance away one of our neighbours has none."

On the 23rd of March, Sir J. Stewart Richardson, who had had great attention bestowed on destruction of Red Spider during 1893, wrote me:—"I have not heard of any reappearance of 'Red Spider' on my Gooseberry-bushes, but shall have a thorough investigation this afternoon."

Sir J. Stewart Richardson then added with regard to the mixture which he had used beneficially for spraying with:—"It is indeed most

satisfactory to find that our useful Anti-pest is so nearly related to Professor Riley's 'Kerosine Emulsion.'

This "Kerosine Emulsion" has been found in the United States to be a thoroughly effective remedy for a very similar kind of "Red Spider" infestation, especially "when a small quantity of flowers of sulphur has been added."

One of the recipes given by the Department of Agriculture of the U.S.A. for the preparation of Kerosine Emulsion is as follows:—Add one gallon of water, in which a quarter of a pound of soft-soap (or other coarse soap if preferred) has been dissolved, boiling or hot, to two gallons of mineral oil, then churn the mixture by action of a syringe, or pump, for about ten minutes to the consistency of cream, and if this is properly done, the ingredients will not separate after standing. For use as a wash or syringing, the "Emulsion" must be diluted with at least nine gallons of water to each gallon of Emulsion.

This mixture of soft-soap and kerosine, or paraffin, or other mineral oil, is exceedingly useful for insect destruction; possibly, or probably, no other insecticide ranks with it as a generally serviceable application, *if it can but be got to remain as a mixture*. This, however, is the difficulty. If the soap-wash and oil are not so thoroughly blended in mixing that they remain permanently incorporated, the application may do more harm than good. The soap-washes may or may not answer the purposes for which they were applied, but the paraffin oil, running by itself on the leafage, is almost sure to do mischief. Even in the U.S.A., where this Emulsion is so valued, the difficulty of mixing it properly is an acknowledged drawback, and it is still more so in this country. It can be learnt by a lesson, but for those who have not this opportunity, or (like myself) have not acquired the proper knack without being shown, I believe that the "Anti-pest" referred to by Sir J. Stewart Richardson is a safer application. This is very nearly indeed allied to the Kerosine Emulsion in nature of its ingredients, and is sold by Messrs. Morris, Little & Son, Doncaster, in form only needing diluting with water to be at once fit for use.

The following note as to serviceableness of the "Emulsion," and especially of it when used hot, was sent me on the 25th of March by Mr. J. Masters, of Evesham, from whom observations on details of fruit-growing are of much value. After remarking on the serious nature of the "Red Spider" infestation, Mr. Masters observed:—"We have found here that nothing has proved more effective than the 'Kerosine Emulsion,' as recommended in your 'Manual' of 1890, pages 348—349. We have found that it is best to apply the preparation to the bushes hot, say 80 to 100 degrees Fahrenheit. We boil the water, in which we put the Emulsion in the proportion recommended; in this state we cart it away to our gardens in a barrel, and

apply it to the bushes by the Knapsack Pump as soon as possible. The test is for the preparation to be as hot as the men can endure it to their backs. The results have been very satisfactory,—death to the Spiders without injury to the foliage. It should be done on a sunny day, as the Spider is then on the upper surface of the foliage, so that the spray comes immediately in contact with them.”



Knapsack Sprayer.

This point of the Spiders collecting on the leafage, and the desirableness of spraying whilst the sun is on, was noted by various contributors, and amongst other observations in a leaflet of directions for treatment written by Mr. Nixon, before mentioned, and distributed largely by Messrs. Morris & Little, of Doncaster. In this it is mentioned, at p. 3:—“Bushes should always be syringed when the leaves are dry, after 9 a.m., and preferably when the sun is shining, as then most Spiders are on the surface of leaves, where they can be the most easily got at, taking care to wet all the foliage. If it is likely to be a frost, the syringing should cease about 4 or 5 p.m. in order to allow the foliage to dry before the frost comes on.”

It is obvious that, to get rid of the Spiders, it is desirable to destroy them in all their lurking-places, whether on leaves or stems, and that if they are only to be found on the leaves during some hours of the day, that then is the time to give the applications; but under submission to those who certainly understand thorough practical treatment more fully than myself, I should say that as soon as the sunlight became warm and powerful with the advancing year some care would have to be exercised lest the leaves moistened in the hot sunlight should become what is called “scalded.”—ED.

Information of complaints being general as to Red Spider presence on Gooseberries, and also of some of his own trees being badly infested, was sent me on the 10th of April by Mr. Edw. Goodwin, from Canon Court, Watlingbury, Kent, with the remark accompanying:—"We are again having a phenomenally dry and warm spring, and its effect on insect life is already apparent."

From various other localities (though not, so far as I find in the past season, further north than Yorkshire); from Beaford, N. Devon; Toddington Fruit-grounds; and from Holt Castle, near Worcester, observations or enquiries were also sent me about Red Spider. In writing from the latter place on the 29th of March, Mr. J. H. Wake-man Best observed:—"Red Spider is very bad in this district on the Gooseberry-trees, particularly on the light soils. I am spraying with Stott's 'Kill'mright.'"

It is worth noting relatively to influence of heat and drought on this attack that, whilst in the dry months of 1893 (see p. 62) the presence of the pest was reported from the 15th of March to the 21st of June, in the past season, though the attack was observed in a few localities much earlier, namely, about the 4th of February (presumably from the unusual numbers which had survived from the great prevalence of the previous year), that it also ended much earlier; only a few notices of its presence were sent me after March, and none after the later part of April.

In connection with the appearance of this mite to an unusual extent on Gooseberry-bushes in this country, as above mentioned, it is of interest to note that another species, the *Bryobia nobilis*, C. L. Koch, was observed by Dr. Fr. Thomas, of Ohrdruf, in Germany, as very prevalent on Gooseberry-bushes (where it had not previously been observed as an infestation) in 1893 and 1894. Of this he remarks, after some preliminary observations on weather influences:—"I am of opinion that the increased amount of appearance of the small red Mite of the Gooseberry-bushes, which was observed in the course of the year 1893, and especially in the spring, was a result of the abnormal dryness of that year, a condition which was repeated in April and May of the present year" * (1894, Ed.). Dr. Fr. Thomas remarks that these insects are not new in Germany, as he had himself seen them for some years in his own garden, but that he was not aware of them having been spoken of in German publications on garden or orchard cultivation, or on plant diseases.

This is such a very similar case of appearance to that of the Red Spider in this country—inasmuch as both of the species of *Bryobia* were known of as respectively present in the respective countries, but

* 'Die rote Stachelbeer Milbe, *Bryobia nobilis*, C. L. Koch (?),' von Prof. Dr. Fr. Thomas, in Ohrdruf (aus Wittmack's 'Gartenflora,' 43 Jahrgang, 1894).

yet not as being injurious to the Gooseberry-bushes, until, in both countries, similar conditions of drought occurred in 1893, which were repeated in the spring of 1894—that it seems desirable to record the parallel observation.

The kind of Red Spider which has been troubling us in Gooseberry-ground during the past two seasons, is of the shape figured, magnified, at p. 62, and is distinguishable from the Red Spider of the Hop by the great length of the front pair of legs. Where there are several of the *Acari* together, their presence may be observed by the little patch of reddish colour; otherwise they are hardly distinguishable by the naked eye, as each "Spider," or Mite, is only about the thirty-second of an inch (that is, the quarter of an eighth of an inch) in length. The colour of the Mites was of some shade of brick-red, varying from bright to ordinary brick colour, and sometimes much darker and duller in tint.*

PREVENTION AND REMEDIES.—The preventive measures lie to a considerable extent in being on the alert, and taking the attack in good time. Where one or two bushes only are found to be infested, it is best to sacrifice them. If they are cut down and *burnt directly*, this will save a deal of trouble, especially if some treatment is applied to the spot where the bushes stood. If the surface soil is turned well under (not merely dug, which often is more a dispersion than a cure of insect presence), and a good soaking with water given, probably the mischief would be got rid of.

In Dr. Friedrich Thomas's publication, previously quoted, he mentions that the continued application of moisture partially stupefies the Mites—that it causes a lethargic condition, from which they recover on being dried by surrounding circumstances, but in which, if continued for some days, they waste. From this it would appear that if infested surface of the ground was turned down and thoroughly well wetted, especially if some soft-soap mixture was added which would still further choke their breathing-apparatus, it would do a deal of good as to what might be in the earth.

From the past season's observations, it is obvious that well washing down the bushes with whatever mixture may be preferred as soon as ever the first beginnings of Red Mite presence are noticeable is very important. Thus we clear off, whilst still numbering only scores or hundreds, what before long would have multiplied to countless numbers.

* For details of this attack, with determination by Mr. Albert Michael of the species as *Bryobia pratensis* of C. L. Koch, and its possible similarity with *B. speciosa* (figured also at p. 62) of the same observer, and other points unnecessary to repeat again this year, the reader is referred to my paper in my 'Seventeenth Report on Injurious Insects,' pp. 32—38.—Ed.

With regard to washes, the Kerosine Emulsion appears to stand first of all on the widespread evidence of its success in the United States for this kind of infestation. We have also observation of it being useful in this country for clearing off this Spider, or Mite, especially when the spray or wash is applied warm (see pp. 65, 66).

The Anti-pest of Messrs. Morris & Little, Doncaster, and Mr. Stott's application sold under the name of Kill'mright, are both serviceable, but I incline most to the former, as its composition much resembles that of the Kerosine Emulsion, only (as observed at p. 65) there is not the same difficulty in mixing it. But probably many soft-soap mixtures are useful, and, amongst others, the "Soap and Sulphur Compound" of the Chiswick Soap Co., Chiswick, Middlesex.

For distribution of sprays, the Knapsack Pump, or "Eclair" Sprayer,* appears to answer very well, excepting that I had complaint in some cases of the oily matter of the soap mixture dissolving the material of the collars, so that they got out of order. Relatively to this point, Sir J. Stewart Richardson, who had reported the excellent success of the Anti-pest applied by means of the Knapsack Sprayer, remarked:—"My gardener found that after using the spray pump for some time that it lost its power, so he took it to pieces, and found the india-rubber collar and valves in a sort of consistency like putty; so he got a sheet of rubber and made new ones, whereupon the pump worked as well as ever."

This rearrangement would probably make all right for home use on a moderate scale of work. For more severe work, I believe that collars and washers, which were originated by Mr. Nixon, of Great Eversden, near Cambridge, and sold by him at threepence apiece, answer quite well. These are not made of india-rubber, but of a material which is not acted on by either oils or acids.

These rearrangements would keep all in order, even if the difficulty still exists; but as I was informed that negotiations were in progress some time ago with Mons. Vermorel, whose Knapsack Sprayers are imported into this country by Messrs. Clark & Son (see previous note), relatively to altering this point, very possibly there is now no difficulty on this head, and certainly all information would be given by Messrs. Clark.

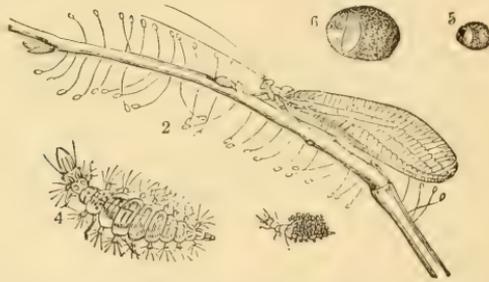
Other means of lessening the amount of the Gooseberry Red Spider lie in cleaning and scraping rough bark (especially during winter), so as to remove shelters for these Mites or their eggs, also in pruning off as much rough wood as could be spared; and running soft-soap into angles between the branches would also be of use. But though the

* Procurable from Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C.

attack was very serious in 1893, and also for a while in the past season, it seems to me that looking at the proof we have of its appearance having been greatly connected with the prevalence of unusually dry weather, there is great reason to hope that with care for a while to get rid of the remains of this extra presence we may not have much more trouble about it.

HOP.

Golden Eye. *Chrysopa perla*, Linn. (Beneficial insect).



CHRYSOPA PERLA.—Fly, magnified, and stalked eggs; larva, mag. and nat. size, cased with rubbish; also cocoon, mag. and nat. size.

During the past season, the two most important kinds of Hop infestations, those of Hop Aphis or Fly, and of Red Spider, have as usual been present; but the history of these, and what may be called the *artificial* remedies, are so perfectly well known that there is no occasion to enter on them again. But with our *natural* remedies the case is different, and the insect foes, such as the Golden Eyes, or Lace-winged Flies, and the Lady-bird Beetles, of which the variety of kinds is not sufficiently known (nor in all cases their entirely beneficial character), may be usefully mentioned.

In the past season the *Chrysopa perla*, one of our very common species of "Golden Eye," was found hibernating in two localities in the south-east of England, early in the year, in such unusual numbers as to make it appear at least likely that this quantity of indoor shelterers were, like the unusual numbers of Wasps and some other infestations of the early part of 1894, remains of the specially great numbers of these that were present in the preceding year.

An enquiry sent me on the 10th of February from a correspondent writing from Frogholt, Hythe, Kent, mentioned the remarkably large

numbers in which the flies were found sheltering indoors, and also their delicate appearance, as follows:—"The house of a friend of mine has been infested this winter with great numbers of (to all appearance) Trout Flies! An unoccupied room has been principally troubled, but the flies have been found all over the house, which is large and old-fashioned"; and enquiries were sent as to the nature of the visitors, and the probable reason for their appearance.

A little earlier (in the latter part of January), a number of *Chrysopas* were sent me from a locality near Hastings, with mention that the flies were very numerous in the house, and the just remark relatively to their remarkable fragile and delicate appearance, that the creature looked much more fitted to make its appearance in the summer than in the winter.

A good supply of these *Chrysopas*, or "Golden Eyes," were sent me, almost all apparently of the very common kind, the *C. perla* (figured somewhat larger than life at p. 70); but as they were dead, and had previously been in a state of hybernation, and the colours consequently not in their proper brightness, it was possible some of the others of the dozen or so of English kinds might be present. This especially in the case of one specimen variously marked with rosy or pink, which might very possibly be the *C. carnea*, a kind just a little larger than the *C. perla*.

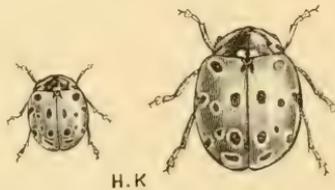
This kind (the *C. perla*) is from about a third to half an inch in the length of the body, and from a little more than one inch to an inch and three-quarters in the spread of the four beautifully iridescent gauzy wings. The *Chrysopas* are generally green; this kind is of a palish or yellowish green, the horns long and thread-like, the eyes globose, and during life of a rich golden tint, from which these insects take their name of "Golden Eyes." The name of Lace-wings, also sometimes given, well describes the light wing-texture with its many cross nervures.

The grubs are carnivorous,—in the words of John Curtis, "ferocious little animals,"—some of which (see figure, p. 70) clothe themselves with the skins of the insects which they have swallowed the available portions of, others cover themselves with lichens, and thus, hidden from their own bird enemies, watch for their own insect food. They have been observed to seize an *Aphis* with their long and strong jaws, and devour the largest in half a minute, or, failing more acceptable food, would eat each other, or even suck the contents of a caterpillar much larger than themselves. The colours of these grubs are various, but appear to be whitish or fuscous, with brown or orange spots, and at the sides of the body are fleshy tubercles, with a spreading tuft of hairs attached to each (see figure 4, magnified, p. 70); they have strong jaws, six feet, and "the apex of the abdomen is prehensile,

forming as it were a seventh foot, which has the power of adhering to very smooth substances." This power it may be remarked is of especial use in steadying the grub in its struggles with the insects of which it is devouring the contents. The grubs feed for rather more than a fortnight, then form a silken whitish cocoon, in which the change to pupa takes place, and from which the flies come out in about three weeks in summer. These are not long-lived; and the female lays her eggs in the curious form figured: applying the tip of her abdomen to the place where the egg is to be attached, she exudes a gummy matter, and drawing it out, leaves it as a fine transparent thread, with the egg fixed at the apex or free end, looking altogether not unlike a pin with the head on an exceedingly fine stem.

I have extracted the above notes of the life-history of the "Golden Eye" mainly from the long and good account given by John Curtis,* as I have never had more than occasional opportunities of observing this beautiful and very beneficial insect and its stalked eggs myself, and it is not so well known as it ought to be. Also it is noted by Curtis that the flies which come forth in summer are not long-lived, but the autumnal ones remain through the winter in cocoon, therefore it appears that the observations of the "Golden Eyes" in the numbers found in mid-winter of this year is an unusual circumstance and worth recording.

"Lady-birds" (beneficial insects).—**Eyed Lady-bird Beetle.** *Coccinella ocellata*, Linn. **Minute Black Lady-bird.** *Seymus minimus*, Rossi.



COCCINELLA OCELLATA, nat. size and magnified.

On the 1st of October, a specimen of the very fine kind of Lady-bird Beetle figured above was forwarded me by the Editor of the 'Hop Grower,' Wolverhampton, with the remark accompanying: "One of my correspondents, a Hop-grower in Kent, has sent me the Lady-bird enclosed, asking me to name its species," &c.

The specimen proved to be the Eyed Lady-bird, the *Coccinella ocellata*, mentioned by Rye as the largest of our species, and "conspi-

* See 'Farm Insects,' by John Curtis, pp. 77, 78.

cuous for the yellow rim surrounding each of its spots during life." * The beetle sent was rather over three-eighths of an inch in length (that is, not quite the full size at which they are sometimes found), and, being alive and uninjured when it reached me, the colouring was in full perfection. The specimen had the head black, with two frontal spots, and the front and side margins white; the thorax (or fore body) also black, with a narrow white margin in front, and a broad one on each side, these broad margins bearing on each (towards the base) one black spot with two white spots in its centre. The wing-cases were rufous, or reddish, in colour, with eight black spots ringed with pale yellowish colour on each. These spots were arranged as one at the base of the wing-case, then three arranged across, then three again, and a longer shaped spot near the tip of the wing-case. These eye-like spots with the black centres and light rings give the scientific name of *ocellata* to this species, of which the term Eyed Lady-bird is a convenient alteration.

There are several varieties,† of which one has the elytra, or wing-cases, unspotted; one has "one or other of the spots on the elytra deficient"; and another has the spot on the shoulder only partly ringed, and has also a small spot quite at the base of each wing-case in the centre (the two spots close together), the other spots only indicated by pale marks.

In the specimen sent me, the shoulder spot was only partially ringed, and the marking on the suture near the scutellum was very clearly defined.

This species is said by Rye to be one of those peculiar to Fir-trees; Stephens notes that it affects Pines and Firs, as well as the Beech; and the specimen figured was found on a Hop-leaf belonging to a Golding growing in an old Hop-yard in the parish of Yalding, Kent. On enquiry of Mr. R. H. White, 9, Bentinck Terrace, Regent's Park, who had captured the insect, whether he could favour me with further details, he could only tell me as above, that "the Lady-bird was obtained from a white bine (or old Golding) Hop-leaf," adding the remark, "which Hop, as possibly you may be aware, is one of the hardest to grow, being peculiarly liable to suffer so much from the attack of Green Fly."—(R. H. W.)

As this Eyed Lady-bird, although in regular course found on Pine or Fir, has certainly previously been found on Beech, and now this specimen was found on Hop, there seems at least a chance that if attention was directed to the subject it might be found more present than is supposed, and with such an observable and good-sized insect, something might really be practicable towards propagating or preserving

* 'British Beetles,' by E. C. Rye, p. 229.

† See Stephens's 'British Entomology; Coleoptera,' vol. iv. p. 379.

it during winter in the way suggested sometimes, though by no means easy to carry out with the smaller sorts.

All the *Coccinellida*, or Lady-birds, whether large or small, are carnivorous both in grub and beetle state, and if by transference from elsewhere, or protection if found on the spot, we could manage to gain the help of this large kind on our Hops, it certainly would be desirable.

“MINUTE BLACK LADY-BIRD,” *Scymnus minimus*, Rossi.—This exceedingly small beetle, it will be remembered, was observed early in August, 1893, by Mr. Edw. Goodwin, of Canon Court, Watlington, near Maidstone, doing much service in grub state by feeding on Red Spider on Hops, and in the past season it has reappeared to some slight extent.

This little beetle is similar to the common Lady-birds in shape, but is only about, or rather less than, a twelfth of an inch in length, black, with the wing-cases slightly downy. The maggots appear, as seen with the naked eye, to be of a general smoky-grey colour; seen through a magnifier, they are of a smoky-yellowish colour, with black patches. These, as also the chrysalids, are similar in shape to the maggots and chrysalids of the common Lady-birds.

In 1893, I had the opportunity of rearing the insect through its various stages, and so observing its life-history, which I am not aware of having been recorded before, and from this, and the notes sent, they were obviously voracious in maggot state. They did not limit themselves to Red Spider of the Hop, for I found they worked steadily onwards at the Red Spider on Plum-leaves greedily and uninterruptedly, and in confinement, failing other nourishment, would feed on their brethren, in one case even until only one survivor remained. The different diet did not seem at all injurious, for in this instance the larva went through its changes rapidly. On August 28th it was still in larval state, and after changing in the usual manner of the Lady-birds to a pupa (in this case shiny and black) hung up by the tip of the tail, I found, on the 6th of September, the little black Lady-bird walking briskly about.

My own attempts to rear a succession of this minute *Scymnus* from specimens I freed in my own garden quite failed; but where they may chance to be noticed, it would be well to remark that the small black beetles, hardly as big as the letter “o” in these lines of print, are beneficial, and are doing good service, and I repeat just a few of last year’s observations in the hope of drawing attention to them.

Note.—Some observations regarding Eelworm presence noticed at Hop-roots at one locality in Kent have been placed under the heading

of "Eelworms" (and more especially at pp. 52—60 of the paper), in order to give considerations of the main characteristics of the different kinds of Nematode worms mentioned, with the figures of them in different stages, *together* for convenience of comparison.

HORSE.

Horse Warble Fly. ? *Hypoderma Loiseti*, Loiset=? *Ædemagena equi*
=? *Hypoderma equi*.

The following note, with which I was favoured on Dec. 17th, by Mr. Samuel Hall, of 3, St. Andrew's Place, Cardiff, is of especial interest as an observation of warble-maggots being found at one time (in the latter part of February) to the amount of at least forty on a mare in his possession. So far as I am aware from observations sent me, or from record, it is very unusual in case of Horse Warble attack to find more than a very few maggots on one animal; for the most part there appears to be only one, and I have never had notes of more than three maggots at one time being observed.

In 1886, the only year in which I have had more than a few cases reported of this attack, Mr. Stratton, of The Duffryn, Newport, Mon., mentioned, "You seldom find more than one on a horse, and that one is sometimes not on the back"; and Mr. Hy. Thompson, M.R.C.V.S., of Aspatria, Cumberland, writing about the extensive diffused swelling caused at the neck of a horse then under his care for presence of warble-maggot, observed regarding the specimen he sent me, "This is the third from the same animal, which is very peculiar, as you seldom see them."

During the past season a very few notes of Horse Warble were sent me, but none adding to our previous amount of information, until Mr. Hall favoured me with the following remarks:—

"I thought it might be of interest to you to know that I had a mare this year with a great number of warbles on her shoulders, back, and quarters. I bought her at Cardigan last January; she had been kept out of doors till about a fortnight before I bought her, and was very low in condition; at that time there were none observable, but about the middle or end of February she had at least forty, so that it was difficult to put a saddle or harness on her. Many of them my man squeezed out; but on those not so advanced, I applied a small

bit of biniodide of mercury ointment, which destroyed them all in about a week or ten days. The mare had a very fine coat, and was five years old.”—(S. H.)

Whether the Horse Warble Fly is of the same species as the Ox Warble Fly,—that is, whether it is the *Hypoderma bovis*,—does not appear yet to be fully known. Various names have been provisionally given to it in the larval stage in which it has been recorded, but up to dates of *published* information in my hands, the fly had not been reared, neither had the maggot been secured for description in its full-grown state. Dr. Brauer (a translation of whose description of the partly-grown grub* I gave in my ‘Tenth Report on Injurious Insects,’ pp. 90, 91) observed:—“To distinguish whether it is the larva of the *H. bovis* or of another kind, we must know the third stage. It is very likely it belongs to another kind, possibly the *H. silenus*.”

The maggots which were seen in our English observations were not sufficiently minutely noted as to show which species of *Hypoderma* they might belong to. They had prickles, and also mouth-forks, like those noticed in the young Ox Warble-maggot, see figs., pp. 5, 9 of Appendix. Amongst all the observations, only two instances occurred of the fly being reared, and in both of these the flies died, and shrivelled or putrefied so very soon that I had not the satisfaction of seeing them for purposes of identification.

One peculiarity of this Horse Warble attack is that the locality of the warbles is not so specially along the back as with cattle, but also on the neck, flank, and quarter. Also that, though very likely only one warble may be present, the mischief,—that is, the swelling, pain, &c.,—caused by this one may possibly be far more than is caused by any one warble on cattle. The amount of suffering probably depends on position; in one of the worst cases mentioned to me by Mr. Thompson, in which he removed the maggot from the neck of a thoroughbred horse, the swelling was diffused and extensive along nearly all the length of the shoulder-blade, and these parts were very painful.

The larvæ † have been chiefly observed in the more northerly parts of Europe, as the North of France, Belgium, Holland, and on the coasts of the North Sea; also we find it distributed generally in England; and it is stated that such horses especially suffer as were exposed in July and August of the previous year to possibility of the Warble Fly attack.

The following notes, for which I was indebted in the course of my

* See ‘Monographie der Cestriden,’ pp. 137, 138, von Friedrich Brauer: Wien.

† See Dr. Brauer’s work previously referred to; also my own translation of his observations on this attack in note pp. 90, 91, of my ‘Tenth Report of Observations of Injurious Insects.’

investigations on Ox Warble to Mr. John Dalton, Wigton, Cumberland, may be of interest as explaining (in connection with the above observations) why traces of warble-presence are so little noticed on horse hides:—

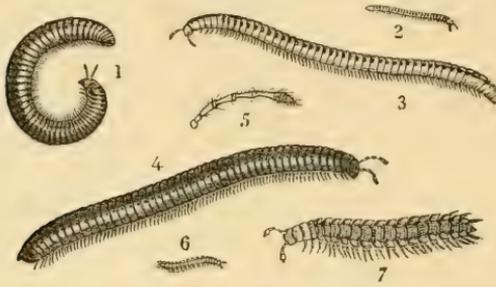
“With regard to your question about warbles in horses, I can give you but little information. Of the horse-hides I get, I should say not one in fifty is warbled, and the appearance of the hides when tanned shows that warbles are of rare occurrence; *there is no cicatrix as in cattle*, and when a warble does exist, it is a single one, and never, so far as I have seen, in numbers. As horses are not used for food, the hides are comparatively scarce, and only a few—and those mostly old ones—come under the observation of the tanner. I never remember seeing more than *one* warble-hole in a horse-hide; I mean in any single hide. Whether it is the same species of warble as in the ox, I cannot give an opinion; I am inclined to think it is the same, . . . but this is of course mere supposition.”

In regard to presence of warble in imported hides, Mr. Dalton wrote:—“Horse-hides are imported in large numbers from South America; the Spaniards rear horses in immense quantities, and kill them for the hides and feet. They are slaughtered at two or three years old, and these hides are quite free from warbles.”

The great number of warble-maggots found by Mr. S. Hall on his mare seems to open up still more than before the question whether the attack may not be at least sometimes of our common Ox Warble Fly. Any way, it would be very desirable to have more certain knowledge on the subject, and if any of those into whose hands this paper may come would favour me with specimens of the maggot which they may have squeezed out when near maturity, I should be very glad of the opportunity of investigating the characteristics, describing, and, if possible, figuring it.

If circumstance allowed of the maggot *not being removed*, so that it might drop out when ready for its change, I would most gladly on application describe the very easy way in which it might be secured so as to give us a chance of rearing the fly.

MANGOLDS.

Snake Millepedes. *Julidæ* of various species.Flattened Millepede. *Polydesmus complanatus*, Linn.

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

Julus-worms, or Millepedes, of various kinds, sometimes also known as False Wireworms, are one of the kinds of infestation which are much requiring fuller observation, and I place them here under the heading of Mangolds as being one of the field crops especially infested by them.

They are well-known kitchen-garden pests, especially the small pale grey kind, with crimson spots along the sides, which we only too often find fairly luxuriating in numbers in our best and ripest Strawberries. This kind, the *Julus guttatus*, or Spotted Millepede, figured at 2 and 3 (nat. size and magnified), often changes to a deep crimson or purplish tint after death. Of the other common species figured, the *Julus terrestris* (4) is upwards of an inch in length, of a pitchy colour, with ochrey legs; and the *J. londinensis*, the London Millepede, so called from having been first observed near London, and also at one time found infesting Wheat in Surrey, is of a dark leaden colour, with whiter legs than the *J. terrestris*, or Earth Millepede. The *Polydesmus complanatus*, or Flattened Millepede, a term well describing its appearance (figured above at 6 and 7), is of a greyish or somewhat purplish colour above, and lighter below, and, as far as my own observations go, I should say more especially frequent in collections of dead leaves.

All these kinds are considered to have the same methods of life. Their egg-laying season is stated to be from about the end of December until May, and the young Millepedes when hatched have three pairs of legs. With successive moults, additional rings or segments bearing additional pairs of legs are developed, until, in some instances, there

may be upwards of eighty pairs.* They are stated to live two years before they arrive at full growth and power of reproduction, and also to propagate most freely in undisturbed ground.

The Snake Millepedes have been found to feed on roots of many vegetables, as Corn, Potatoes, Turnips, Onion, Cabbage, &c.; the Spotted Millepede is excessively partial to Mangolds; and the Flattened Millepede is recorded as especially injuring Carrot crops.

That both these kinds attack roots of Peas in the field, is shown by the following communication, which was sent me on the 19th of May, by Mr. Wm. Luton, from Brooklyn Farm, Hambrook, near Bristol:—“I have a piece of Peas that are dying away, and cannot tell the cause; but I find the roots are covered with a small insect, and I think that must be the evil.”

Specimens of the infested Peas, and of the infestation itself, were sent accompanying, and on examination this proved to be of both the Spotted and the Flattened Millepede.

But what we need most particularly to know is,—*where do these Millepedes come from to the attacked crops?* They are not true insects, and cannot fly in any stage of their lives, so that they must either have been bred on the spot, or been carried to it in manure or soil, or have migrated to it; no other way seems open, for it is hardly in the compass of possibility that the eggs could have been carried in seed.

From such notes as have occasionally been given in past years, transmission in manure seems the most likely cause of infestation. Millepedes are general feeders, and consume both decaying and living animal and vegetable substances; their habit of preying on Slugs, Snails, insects, Earth-worms, and the like, would not bear on the present subject; but in kitchen-garden work they are found especially to be present in refuse or rubbish heaps, and also in manure.

On May 31st, Mr. A. E. Palmer, writing to me from Goldthorn Hill, Wolverhampton, forwarded specimens of what turned out to be the Spotted Millepede, asking information how to get rid of them, as his Vine-borders were infested with them.

Where manure from *standing heaps*, often in very much the condition in which it is found in thoroughly-dressed Vine-borders, is carried out to fields, it might very likely take the *Julus*-worms, just as the soil above-mentioned would have done.

In the course of communication in 1883 with Mr. W. Glenny, of

* John Curtis in his ‘Farm Insects,’ which contains the most serviceable account of the common British Millepedes, and from which I quote above, mentions having himself counted, as well as he could ascertain, 156 feet on the *Julus pilosus*; also that there were 160 on the *J. londinensis*; and, speaking of the Snake Millepedes generally, that the number of legs which they possess amounts sometimes to 240.—ED.

Barking (whose opinion on these matters is of much value), he mentioned the damage caused by Julus-worms (in this case the "Earth" and the "Flattened" Millepede) to sprouting Kidney Beans, and added:—"Your suggestions to move the ground frequently before planting, to eradicate all rubbish and garbage, and to sow not too early, are what I can endorse entirely." Of the dispersion of the pests from heaps of rotting or rotten vegetable matter we have plenty of proof, but we want more attention to the "animal remains" part of the question; that is, animal manure, rotting bones, or bone not fully crushed in bone manure, and also what may be called "garbage," as attractions to Millepede presence. In notes sent at different times, I have information of the Millepedes as found in bunches at times round a bit of bone or refuse left in the manure; and also, in some notes sent me by Mr. J. A. Smith, Rise Hall, Akenham, of a remarkably large presence of Earth Millepedes in connection with land which was annually treated with town manure containing slaughter-house refuse, and what may be generally described by the word garbage.

The fact of the Millepedes living two years before they reach maturity causes difficulty in the investigation, but taking for leading points that they may be in *old* refuse heaps, and that they may be found in great quantities in decayed vegetable matter, and also may be found in animal refuse, or at bones used as manure or flung to manure heaps, we might in the coming year make some advance in information.

In the course of the past season, Mr. Winder, writing me on the 21st of June regarding the condition of a crop of Mangolds on land under his superintendence at Fairmile, Ottery St. Mary, Devon, mentioned that the seed had been sown about six weeks, and as it did not appear to prosper,—in fact, many of the plants were dying,—they began to look for the reason, and found grey worm-like creatures, of which he enclosed samples, showing them to be the spotted Millepede, "which were apparently eating the Mangold, or whether they were after the manure I cannot tell. It was what is called bone compound, 3 cwt. per acre, 1½ cwt. guano, and 4 cwt. salt. Salt sown broadcast before sowing."—(E. A. W.)

Mr. Winder forwarded me some of the bone compound for examination, and I could not find any signs of infestation in it, so in that case we got no nearer the cause.

Nitrate of soda applied as a dry dressing had very little effect; but in this and another case the best application was rain setting in, which brought the enrichments in the soil to bear, and saved a moderate crop.

Looking at the observations which have been sent in now from time to time for eleven or more years, we do not find that any remedy has yet been noted for these Millepede attacks when on the broad

scale of field cultivation. Where a strong solution of nitrate of soda, or of salt, can be run down to them so as to touch them, it will kill them very rapidly; but this is hardly possible in field culture, and merely strewing the nitrate or salt will not answer.

In Mr. Glenny's notes of the damage to germinating Beans caused by these Millepedes, he suggested poisoning the seed, and perhaps something of the nature of "pickling" might be managed in the case of Mangolds, as it is just at the time of germination that the mischief is specially done.

Cotton-cake is a great attraction to some kinds of Millepedes, and may be very serviceably used to draw them away from a crop; but whether it may not also to some extent be a means of drawing them to where manure is used in which Cotton-cake was one of the ingredients of the cattle-food is open to doubt.

In a detailed note sent me in 1885 from Audley's Wood, Basingstoke, of one of the worst attacks on germinating Mangold plants that was ever reported to me, Mangold had been grown on the ground very successfully for four years, and in the previous year the land had been treated at the rate of ten tons to the acre with manure from pigs fatted on Barley-meal, cows fed on decorticated Cotton-cake, Maize, and Bean-meal or dari crushed with Mangolds; and also manure from cart stables. The land was ploughed after the Mangold crop was lifted; deeply ploughed and left in fallow all winter. The seed was drilled with ground Rape-cake, and a Mangold manure,* in which bits "of bone or refuse used in the manufacture of the manure" were present.

In this quite exceptionally bad attack, besides the numbers of Millepedes found at the germinating seed, they were also sometimes found in bunches round bits of bone and refuse in the manure.

But again, we do not know how the infestation came to be in such vast numbers on the field where it had not previously been observed, and it seems to me we need special investigation as to possibilities of migration.

In a note sent me in the course of observations by Mr. J. A. Smith, of Rise Hall, Akenham, he mentioned having one morning seen such numbers of Millepedes crossing a turnpike road, apparently travelling from a field of Oats towards a piece of pasture-land, that the road was covered with them. The specimens sent agreed with the common pitchy-coloured *Julus terrestris*, the Earth Millepede.

If we could have some detailed observations regarding habits of these destructive pests, they would certainly be very useful, and I

* Name of this manure given with the observation in my Report for 1885, but unnecessary to repeat.

should be very glad to give any information in my power, for this is one of the attacks about which we do not seem to be making any advance.

Note.—Two other attacks, which respectively are, or may very likely be, at Mangold-roots, require a few words. The first of these was of a species of surface caterpillar which I have not before had notes of, and which was sent from two localities as doing much harm to Mangold-roots. This was very like the common "Turnip Grub," the larva of the *Agrotis segetum*, in shape, and obviously very nearly allied, but was entirely different in colour, being of a decided red or reddish-brown tint along the upper part. As the caterpillars were only partly grown, I could not name them with certainty, but they appeared very possibly to be caterpillars of the *Agrotis suffusa*, sometimes found in June at Mangolds.

The other attack, which may very likely indeed be present at the roots of Mangold, is of serious importance. This is the Beet Eelworm figured and described at pp. 56—58 preceding. We know this kind is in the country, but as yet we have not had report of it as at Mangolds, though from the condition in which young plants have occasionally been sent me for several years back, this Eelworm presence may very likely be the cause of the unexplained failures.

A few lines of description of the appearance of attacked Beet (equally applicable to Mangolds) will be found at p. 59. If any such "sickness" should be noticed in the coming season, I should be particularly obliged by a few specimens being sent me, taken up with the earth adhering to the rootlets, so that the small lemon- or citron-shaped female Eelworms (see figures 4 and 5, p. 56) might be still present for identification.

MUSTARD.

Charlock (or Charlock-seed) Weevil. *Ceutorhynchus contractus*,
Marsh.



CEUTORHYNCHUS CONTRACTUS.—Natural size and magnified.

The exceedingly minute weevils figured above, which in 1893 did much damage to germinating seed and young plants of White Mustard on the grounds of Holderness Mustard-growers, reappeared similarly in the past season in the Holderness district in vast numbers during April on the young Mustard, and later on were reported by hundreds on the Mustard in the neighbourhood of Hull.

On the 2nd of May, Mr. H. L. Leonard, writing from Preston, Hull, mentioned:—"I regret to inform you that the small weevil (*Ceutorhynchus contractus*) is again present on our Holderness Mustard crops, and is doing a large amount of damage. Some crops were sown very early, and were bitten by a sharp frost on April 21st; this checked the growth of the plants, and the weevils completely destroyed them in three or four days. They have not worked under the surface this year, but have eaten the leaves, and also through the stem.

"Later-sown crops are being checked in their growth a good deal by these insects, but I hope with fine weather the plant will grow away from them."

On the 12th of June, Mr. Leonard reported again on the condition of the crop relatively to weevil presence up to date of writing, giving the earlier part somewhat more in detail, and also drawing attention to the importance of conditions calculated to press on a strong healthy growth as a means of lessening the effect of insect ravage.

Mr. Leonard wrote:—"The weevil appeared in the Holderness district in April in immense numbers on our young Mustard-seed crops. They ate the leaves a good deal, but, owing to the favourable season, the plants grew away without any serious injury being done, excepting in three cases where the farmers sowed their seed during the last week in March or the first week in April, which is much earlier than usual. In these cases, just at the time the plant was breaking into the broad leaf, we had a very sharp frost, which so checked the growth, that the weevil attack completely destroyed it. The land in each case was sown over again, and no further damage has been done by this insect."

Mr. Leonard also observed with regard to kind of manure used:—"Of three large farmers who have had to sow again, one used foldyard manure only, another a compound manure, and another simply ground bones, so that the kind of manure used cannot have any effect on the prevalence or otherwise of the weevil."—(H. L. L.)

The exact method of injury, that is, the exact part attacked by the weevil, varies a little, but apparently this is according to what the then state of the plant may afford to be preyed on. At first damage is reported to be by the weevils eating the germinating seed, which necessarily destroys the small young sprouting plant; later on they will eat off the first leaves just after they have sprouted below the ground; or, when it is a little more advanced, will nip them off just above ground; or will attack the developed seed-leaves, including Turnip or Charlock leafage in their ravages; and in the course of last season's observations (though I am not aware of this being noticed before) the beetles were observed in great numbers on what must have been a much more advanced growth, as on shaking the plants the weevils could be heard falling to the ground.

The note regarding this was sent me on the 19th of July by Mr. Alfred C. Cully, from the Carrow Works, Norwich, as follows:—"I have this day found on some White Mustard-seed in the neighbourhood of Hull some kind of weevil. There are many hundreds of them on the plants, and with the slightest shake you can hear them drop on the ground like so much shot.

"The farmers in the neighbourhood say that these same insects ate off the young plants almost before they showed above ground in the early spring, and consequently several fields were resown.

"I rather questioned this, and suggested that it was probably the Turnip Flea, but my informant is positive that these were the aggressors, and that he saw hundreds on the ground then. . . . I may say that in the same field were some Mustard Beetles proper, and their grubs, but where there was one of the latter, there seemed to be a score of the former."—(A. C. C.)

In this instance, the leaves, of which specimens were sent, were

advanced to some size, and on examination there was no reason to doubt the *Ceutorhynchus* beetles sent accompanying being of the species *contractus* from their agreement with type specimens.

This beetle is to some degree distinguishable from the two other common kinds of weevil which may be found on Turnip and Mustard (namely, the *Ceutorhynchus sulcicollis*, or "Gall Weevil," and the *C. assimilis*, or "Seed Weevil") by its smaller size, which is only about half to three-quarters of a line in length. The general tint is shiny black, the wing-cases sometimes having a greenish glance; the fore body is narrowed, and crossed by a deep groove in front, and strongly punctured above. The proboscis is long and slender and arched. The wings are ample, but so finely nerved, that with a magnifier of two-inch power I was only able to distinguish the larger veins figured at p. 83.

The last season's observations have given a point of what may prove of very practical interest, in the note of the *contractus* weevils being found in great numbers as late as July 19th on the growing Mustard (not merely at the young sprouting plant). As yet, so far as I am aware, we have no knowledge at all of where the early stages of this weevil are passed, excepting that it has been reared from galls on Charlock-roots.

This, however, can hardly be the place from which such legions come, which sometimes occur when weather is favourable for them and bad for growth of the Turnip or Mustard crop. Those that appear in April may very likely have hybernated; but this can hardly be the case with those that are found in June, still less those that were found last season dropping in such quantities from the Mustard plants that their fall could be heard as late in the season as the 19th of July.

One way of gaining some advance in information would be dissecting specimens from the time of the first observation onward, until we found presence of eggs within the females. With sufficiently powerful magnifiers this would give us a clue, and once found, the experiment might be followed up by confining specimens with their food-plants still growing, and watching for results. It would be worth some trouble to make out the history of this (occasionally) very destructive young Mustard and Turnip pest, and I should be glad to do what I could in the matter.

Last season's observations have somewhat helped by showing that in unfavourable circumstances, as where a crop is held back in growth by frost, it may very likely be completely cleared by the weevil, whilst the resowing on the same ground, but under more favourable circumstances for growth, will do well.

We have also amongst notes sent in at various times an observation of bad infestation of this *C. contractus* weevil occurring on ground

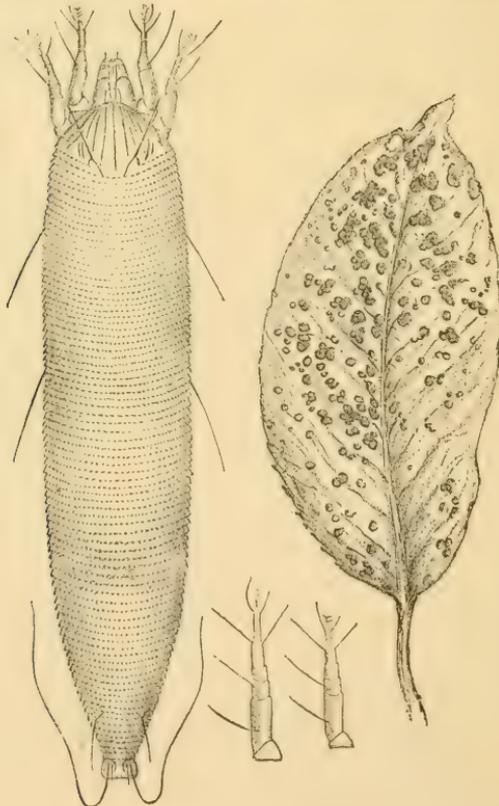
where the crop of Oats preceding had been so full of Charlock that the field was yellow with the flowers. In the index to Curtis's 'Farm Insects,' there is a reference at p. 519 to this *Ceutorhynchus contractus* as the "Charlock seed Weevil"; and though nothing further appears to be said on this head, still in the great want of information some search into what Charlock-pods might show would be worth while.

So far as remedial applications go, we have no notes of what have been tried being of much service.

PHYTOPTIDÆ.

Pear Leaf-blisther Mites. *Phytoptus pyri*, Nalepa.

Black Currant Gall Mites. *Phytoptus ribis*, Westwood and Nalepa.



PHYTOPTUS PYRI, female, nat. 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 Pear-leaf disease known as "blister," caused by a very minute Mite (figured at p. 86 enormously magnified), is an infestation which 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 partly because hitherto in this country little has been known as to reliable measures, easily carried out, for keeping the mischief in check.

In the United States and Canada, however, the "leaf-blister" disease increased of late years to such a serious extent that special attention has been bestowed on the subject, and some very good information on its life-history and practicable remedial measures were given by Mr. J. Fletcher, Entomologist of the Dominion Experimental Farms of Canada, for which see "Report of the Ontario Fruit-growers' Association," p. 113, published in the 'Annual Report of the Department of Agriculture of Ontario for 1892.'

Experiments were also set on foot in 1892, and repeated (to ensure correct observation) in 1893, at the Agricultural Experiment Station, Cornell University, New York State, U.S.A., and the main points regarding the treatment which proved very successful, and the life-history of the pest, were embodied in a pamphlet of about ten pages in length, by Mr. M. V. Slingerland (Assistant Entomologist, Cornell University), which may be strongly recommended to all needing information on the subject.*

In my Report for 1893, I gave as much of the minute technical characteristics of this Pear Leaf-blister Mite as can be needed for most practical observers, from the description by Dr. Alfred Nalepa in the part mentioned below † of his long series of elaborate works on the Gall Mites published in 'Reports of the Proceedings of the Imperial Society of Vienna'; but for common use, the following short note of the appearance of the diseased leaves, and of the Gall Mites, which cause the blisters, may be of service.

The disease shows itself in the form of blister-like spots, somewhat raised on each side of the leaf, and in the middle of each little blister beneath the leaf is a little hole, which gives access to the central cavity, and also gives passage out at pleasure to the Mites. The spots or blisters may be found on the Pear-leaves whilst they are still quite young, but later on, when they are expanded, is the period at which

* Bulletin 61, Dec., 1893. Cornell University Agricultural Experiment Station. By Mark Vernon Slingerland. Published by the University, Ithaca, New York, U.S.A. Procurable through Messrs. W. Wesley & Son, Essex Street, Strand, London, W.C.

† Nalepa, 'Zur System der Gallmilben,' Sitzber. 1890, pp. [50, 51] 11, 12, plate iv., figs. 1, 2. See also references in 'Katalog der bisher beschriebenen Gallmilben,' by Dr. Nalepa, pp. 275 and 296.

they are most noticed. They may be red or green, or red on one side of the leaf and green on the other, and later on, presumably from death of the diseased tissues, the blisters turn blackish or brown in colour.

Though it is only within the last few years that anything to call enquiry worth speaking of has been sent me about these leaf-blisters, I have myself had them more or less under observation since about the year 1876, and have found that confusion is apt to arise between these blisters and the small discoloured patches of mere vegetable disease often found on Pear-leaves, and sometimes known as Pear Scab; but a little examination with a hand-magnifier, so as to distinguish the swelling of the blister on both sides of the leaf, and the central hole below, and if a section is cut, the disorganized tissue with something of a cavity between the two sides of the blister, with very possibly the long cylindrical Gall Mites within, will show the difference.

The above are well-marked points, and, as will be seen by some of the following communications sent me in the past season, catch the eye at once.

On the 30th of April, Mr. W. H. Burbidge, writing from Marlins, Guildford, forwarded me specimens of bad attack of Pear Leaf-blisters Mite, with the observation:—"Enclosed I send you a few leaves from a Pear that appears to be attacked by some insect. I see a small hole in the centre of the swellings (under side of the leaf) with the microscope, but I cannot discover any insect in the blister-like places.

"Last week, in Somersetshire, I saw two Pear trees similarly attacked; there the very young leaves that had not even uncurled seemed affected."—(W. H. B.)

A few days later, Mr. Sidney Lee, writing from Crocken Hill, Swanley, Kent, forwarded me some Pear-leaves suffering from the "blister," with the observation that he had a number of trees with leaves in a similar condition. The specimens sent were like most of the others forwarded at that time, with the blister-diseased parts of a reddish or reddish purple colour; and, in the U. S. A. Report above referred to, it is noted (on the first page) that "the disease appears on the Pear-leaves before they are fully expanded from the bud in the spring in the form of red blister-like spots, an eighth of an inch or more in diameter."—(M. V. S.)

Some other observations were sent giving the opportunity of experiment as to remedial treatment noticed at p. 91 under this head.

With regard to the *Phytoptus pyri*, the Leaf-blisters Mite, or Gall Mite, which causes this attack, it is almost or quite invisible to the naked eye, being very much less than one millimetre in length,* and its

* One millimetre is the 25th part of an inch.

breadth only about one-fifth or sixth part of its length. The greatly magnified figure at p. 86, copied by kind permission of Dr. Nalepa from one of his excellent figures, shows the shape perfectly. It is cylindrical, tapering at the tail, with a strong slightly-curved proboscis, and four legs, which are distinctly jointed; the terminal claw, variously known as a "holding-claw" or "feather bristle," is four-branched. The abdomen is uniformly ringed, and rather finely punctate. Without very strong microscopic power, far beyond what most of us possess, it is impossible to identify one from the other the different species of *Phytoptidæ*; but with this Pear "Leaf-blister," the attack may for all practical purposes be identified by the existence of the blister; and with moderately strong magnifiers, the Mites may be distinguished as Gall Mites, or as of the sub-family of *Phytoptidæ*, from others of the order of *Acarina*—to which they belong—by their narrow cylindrical shape, and by having throughout their lives only two pairs of legs. They are hatched from the egg with two pairs, placed as shown in the figure at the fore part of the body, and they *never* have more. This is a most important point to be attended to, as, for want of knowledge of this fact, observations are at times hopelessly confused as to what kind of infestation is present, and consequently what treatment needed.

The history of the attack, taken shortly from Mr. Fletcher's report quoted above, is as follows:—"The Mites, which are hardly visible to the naked eye, emerge from the scales of the leaf-buds early in spring, and attack the tissues of the unfolding leaves. The blisters soon begin to show as small red spots, each of which has a small central hole on the lower side of the leaf. The eggs are laid inside these blisters, and the young, escaping through the central opening, at once form new galls, until sometimes the greater part of most of the leaves is rendered unfit to perform its functions."—(J. F.)

Thus, as may be seen by all who are troubled by these blisters on their Pear-leaves, the attack may go on spreading during the summer. With regard to migration of the Leaf-blister Mites to their winter lodgings, it is stated by different observers that when the leaves dry, and the time of their fall draws near, the Mites leave the blister-galls through the opening, and move to the winter buds, and especially to those at or near the ends of the shoots.

With regard to their condition during winter, Dr. Taschenberg mentions:—"This they pass as larvæ, or as sexed individuals mixed together in the leaf and flower-buds of the one-year-old shoots, embedded in the layer of hair or downy felt inside the outer bud-scales, commonly many together; Herr Sorauer has found as many as seventeen."*

* 'Praktische Insekten-Kunde,' von E. L. Taschenberg, pt. v., pp. 159, 160.

Thus, save what may possibly hibernate in rough bark or accidental sheltering-places, they spend the winter, and are ready to recommence mischief in spring.

METHODS OF PREVENTION AND REMEDY.—Where there are only a few leaves infested, or the trees are small, it is well to pick these leaves off and burn them. Where attack is bad, spraying the leaves is the best remedy, and for this purpose the mixture of soft-soap and mineral oil, known as Kerosine Emulsion, is especially recommended. In Mr. Fletcher's paper, quoted above, it is stated:—"As a remedy, Kerosine Emulsion seems to be the only substance which, up to the present time, has given any promising results."*

I do not feel sure from my own experiments whether, so far as syringing leafage to check spring and summer attack is concerned, other soap mixtures besides those mixed with mineral oil (as Kerosine Emulsion, and what may be called its British counterpart the Anti-pest, previously mentioned) would not do very well. In the working of these applications a great deal depends on the tenacity of the soft-soap choking the breathing-apparatus of the pests, and causing their minute and soft bodies to adhere to wherever they may be affixed until they are dead. But however this may be, I was favoured with a very good note of success in use of Kerosine Emulsion in checking bad attack of this Pear Leaf-blister damage. This was sent me early in May from "The Limes," Sarisbury Green, Southampton, by Mr. F. Keller. Referring to my recommendations as to treatment, he replied:—"I have lost no time, pending the arrival of a supply of the 'Anti-pest' remedy, to apply some Kerosine Emulsion to the injured trees by means of a Knapsack Strawsonizer. This has certainly arrested the damage on those trees that were only slightly affected as yet, and I am in hopes it may yet save the four horizontally-trained Pear-trees, which, on receipt of your letter, had hardly a sound leaf left, the tender young leaves being all rolled up; for the new leaves that have formed since the application of the Emulsion are so far looking healthy."—(F. K.)

In 1893, I had good success with Anti-pest syringed on to the leafage of a wall Pear-tree much injured by blister in my own garden, so that in the past season it did not require any treatment.

But (quoting from Mr. Slingerland's pamphlet before mentioned) "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.

* For recipe for this Emulsion, difficulties as to thoroughly blending the ingredients so that they may remain permanently incorporated, and remarks thereon, see *ante*, p. 65.

After various experiments at Cornell University Agricultural Station, two trees were chosen, of which one was treated with Kerosine Emulsion diluted with two and one-third parts of water, the other tree left untreated as a check. "In the spring the Mites appeared in force on the check tree, but upon the treated trees * not more than a dozen galls appeared during the season, the pest having thus been nearly exterminated!"

This was looked on only as a guiding experiment, and carried on in the following year on a larger scale, as follows:—"In September" (of the first year of observation, 1892) "we found sixteen quite badly infested trees in the Horticultural Orchard here at the Station. These were then labelled, and on March 10th, 1893, all but two (which were left for a check) were sprayed with Kerosine Emulsion diluted with from three to ten parts of water. The trees were standards varying from six to fifteen feet in height; but it was found that it required only about one and a half quarts of the diluted Emulsion, and about two minutes of time, to spray a tree thoroughly from all sides with a Knapsack Sprayer.

"July 10th, 1893, the trees were examined, and it was found that the four sprayed with the Emulsion diluted with three parts of water were practically free from the disease.

"The four trees sprayed with the Emulsion diluted five times, and the four on which the Emulsion diluted with eight parts of water was used, showed a very few galls,—not one per cent. of the number on the trees the preceding year.

"Two trees which had been sprayed with the Emulsion diluted with ten parts of water showed nearly as many galls as before.

"The two check trees were as badly infested as they were the year before." †

From these experiments it appears, as summarized by Mr. Slingerland, 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, for this is where most of the Mites congregate.—(M. V. S.)

* "Trees,"—two trees were dressed with undiluted Kerosine, and nearly killed, thus showing the necessity of being very careful in the use of Kerosine; but as the dozen leaf-galls mentioned above were all to be found on the three trees, the modified strength given in the Emulsion answered well. "The only apparent effect upon the trees treated with the Emulsion was a slight retardation in the unfolding of the leaves in the spring."—(M. V. S.)

† See Bulletin of Cornell University, before referred to.

This information appears to me very valuable, as it has been well tested; is in agreement with what we have from the highest U. S. A. and Canadian advisers, though not in such detail; and also on a lesser scale we have proved its usefulness here. It would appear to be well worth attention of all Pear-growers troubled by the Pear Leaf-blisther Mite.

BLACK CURRANT-BUD GALL MITE, *Phytoptus ribis*, Westwood and Nalepa.—This Black Currant infestation, only too well known to Currant growers all over the country, continues to exist, or even to be increasingly troublesome, and I mention it together with the Pear Mite under the heading of *Phytoptida*, as the nature and habits of these two species of *Phytopti*, or Gall Mites, are in many respects so much alike that possibly the treatment mentioned above as an almost certain method of eradicating the Pear Mite whilst sheltering in the Pear-buds during winter, might in all probability be equally applicable for destruction of the Black Currant Mites when also in winter-quarters in the buds; at least it would be well worth trying.

During the past year, communications regarding this destructive pest were sent at intervals beginning in February up to the 26th of December, but very little advance, if any, was made in method of treatment, excepting a note from Mr. John Speir, of Newton Farm, Glasgow, whose observations are always valuable, to the effect that "the Currant-bushes treated for Mite in 1891 and 1893 still keep quite free." The details of the treatment were given at pp. 91 and 92 of my 'Report on Injurious Insects for 1893.' Put shortly, it consisted in cutting back the stems of the bushes which were very badly attacked to within two or three inches of the ground (the branches being carefully gathered together and burned). A mixture of soft-soap dissolved in hot water, to which paraffin oil was added, and stirred so as to make it combine, was diluted to a safe strength with cold water, and syringed on to the stumps of the old bushes, and on the ground about, and on the neighbouring bushes. The bushes pushed up new shoots, and at the date 29th September, 1893, Mr. Speir reported that during the spring no affected buds were noticed, either on the bushes that were cut back or on the others surrounding them, and during the year the bushes appeared in a very favourable way of making good growth and healthy wood in the future. This good promise has (as shown by Mr. Speir's short note given above) been kept up during the past year, and as in this case, besides what was done to the cut-down bushes, "the bushes round the affected ones were syringed with the soft-soap and paraffin mixture," this point appears well worthy of attention as an instance of success in treating the bushes at the fall of the year, almost precisely as recommended (also at the fall of the year) in the case of the Pear Leaf-blisther Mite.

It appears to me thoroughly worth while to try whether we cannot destroy the Black Currant Mite in the winter buds with soft-soap and mineral oil syringings, just as we find the Pear Leaf-blister Mite has been satisfactorily destroyed.

The infestation has been so often entered on, that it is not necessary to describe it again further than that it is caused by a very minute, cylindrical, four-legged Mite very much like the *Phytoptus* figured at p. 86, both in appearance and habits, save that it gives rise to a swollen growth of the buds until they form mere distorted irregularly-shaped balls of aborted embryo growth of variable size up to half an inch across or more.

Breaking these off and destroying them does something towards checking increase of attack; but we much need a more effective remedy, and where these observations may reach growers whilst the bushes may still be in a condition for the syringing to be tried experimentally, I think it would be well worth while to try how the application might act.

STRAWBERRY.

“Ground Beetles.” *Pterostichus madidus*, Fab.; *Harpalus ruficornis*, Fab.; *Calathus cisteloides*, Panz.



PTEROSTICHUS MADIDUS, magnified, and line showing nat. length.

The following observations of destruction of Strawberry fruit by beetles belonging to a carnivorous division, of which the occasional variations to a vegetable diet have as yet been only partially worked out, are of much serviceable interest. They were sent to me on Sept. 28th from Nottingham by Mr. M. J. R. Dunstan, M.A., Director of Technical Instruction for the County Council of Nottinghamshire; and I may mention that the specimens were identified by a competent

entomologist, and the damage caused by the beetles to the fruit properly observed.

Mr. Dunstan's communication to me was as follows:—"I am venturing to ask your advice with regard to an attack on Strawberries by beetles made last season at Woodborough in this county. The beetles have been identified as of a carnivorous type,—*Pterostichus madidus*, *Harpalus ruficornis*, *Calathus cisteloides*.

"The actual berries were attacked and devoured by the beetles at night, who swarmed on the plants, and the crop was of course ruined. The attack was watched by the farmer, who had three roods devoted to Strawberries, and the beetles themselves seen to be the actual culprits feeding on the berries; no other animals were observed after which the beetles might have come,—in fact, the total destruction of all the berries seems to point to the berries being the object of the beetles' visit. The farmer is naturally anxious to know how to prevent such an attack next year, and, if the attack should occur, how to get rid of the beetles. I should be sincerely obliged if you can give me any information or suggestion that can enable him to deal with the case."

Without going into minute scientific distinctions, it may be just mentioned that the three kinds of beetles mentioned above belong to three different genera of the *Carabidæ*, a family of the predacious "Ground Beetles," of which it was said by the late Mr. Rye:—"Superficially, the *Geodephaga* may be known by their active habits, slaughtering propensities, thin legs and antennæ, and hard outer covering."*

But though feeding on insects or animal matter, as earthworms, mollusks, &c., is their general characteristic, this is by no means wholly the case. The grubs of the Corn Ground Beetle, the *Zabrus gibbus*, are injurious at the roots of corn, and the beetles to the milky grain of Barley in the ear. The capacity of some of the Ground Beetles for causing injury to crops has long been known, and the precise amount to which many of them feed on vegetable matter given in the microscopic investigations of Prof. S. A. Forbes, State Entomologist of Illinois, U.S.A.; and the present well-authenticated observation of injury to fruit, it may be hoped, will give a clue leading to cause of devastations to Strawberry fruit which occur from time to time, but which I have not before been able to trace to the predators.

These three species of beetles are so much alike in general appearance, that the figure of the *Pterostichus* (= *Steropus*) *madidus*, given at p. 93, may be taken as conveying a fair idea of the shape of each of them; when placed side by side, the differences show plainly.

* 'British Beetles,' by E. C. Rye, p. 46.

The *P. madidus* is the largest,—this is from half an inch to two-thirds in length,—of a shining black, with strong jaws, and *no wings*, a very important point. This differs from the two other kinds in the thorax (or body between the wings) being so much rounded behind as to be a good deal narrower than the base of the wing-cases.

Harpalus ruficornis is not so large as the above, but variable, the length being from rather over one-third of an inch to rather under two-thirds; colour pitchy black, and thorax as broad at the base as the wing-cases. This kind is especially noticed by John Curtis as provided with "*ample wings*."

Calathus cisteloides is decidedly smaller, being only from a third of an inch to just over half an inch in length; colour dead black; thorax broad behind, with acute angles; *wings none*.

The antennæ and legs of the above-named *Harpalus* and *Calathus* are red, fuscous, or black; of the *Pterostichus* the legs are black with red thighs.

I am not aware of there being any popular English name for either of these three beetles beyond the general name of Ground Beetles; nor of their larvæ or grubs having been specially described; but the following remarks might probably help in recognizing them:—"A *Geodephagous* larva is 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 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."*

With regard to attack of *Harpalus ruficornis* on ripe Strawberries, a parallel observation will be found recorded by Dr. Ritzema Bos as occurring in the Netherlands in 1892. In his 'Short Notes' (referred to below), he mentions that *Harpalus ruficornis*, F., was sent him "in the summer of 1892 from the neighbourhood of Goes, in Zeeland, as injurious to ripe Strawberries. It was found there in very great numbers on the Strawberry-beds, and was very hurtful. See my observations in 'Biologisches Centralblatt,' Bd. xiii., p. 255."—(J. R. B.)

In this, Dr. Ritzema Bos,—after some observations of the *H. ruficornis* being, as well as the Ground Beetles in general, an insect-eating kind, and some other remarks bearing on the subject,—notes somewhat more at length that in the summer of the preceding year twenty-six specimens of Ground Beetles were sent to him from Kapelle, near Goes (in the Province of Zeeland in the Netherlands); they appeared there in a large kitchen-garden in exceedingly large numbers, and ate

* 'British Beetles,' by E. C. Rye, p. 46.

the ripe Strawberry fruit. On investigation, Dr. Ritzema Bos found that twenty-five of the specimens were of the species *Harpalus ruficornis*, F., and one of the species *Harpalus æneus*, F.*

In Curtis's 'Farm Insects,' pp. 217, 218, he gives an account of his own observation of this same species of beetle about sunset on a hot day in July, 1848, on ears of Wheat in a field at Hayes, Middlesex; he describes them as "running up the stalks, and their great delight was to get to the tip of the ear, where they moved their heads as if about to feed."

In the notes by Prof. S. A. Forbes, U. S. A., of the result of his examinations of food of predacious beetles from dissection and study of contents,† he notes:—"It appears that so far as the specimens of the three species of *Harpalus* examined showed, only about one-eighth of it consisted of animal matter; pollen of flowers, tissue of grasses, and fungi being amongst the component parts of the vegetable food."

The first two items of the vegetable food are presumably what were being sought for by John Curtis's *H. ruficornis*.

The vegetable-eating powers of the Pterostichus (or Steropus) madidus were brought under my own notice in 1885 (see my 'Ninth Report on Injurious Insects,' pp. 51—53). In this case the attack was to the upper part of young Mangold-roots, about an inch to an inch and a half across at the top.

Specimens of both roots and beetles were sent me by Mr. T. J. Mann, of The Grange, Bishops Stortford, Herts, the roots being gnawed off near ground-level, and the workings being in patches and channellings of very distinctive marking. The first beetles sent were captured at 3 a.m. at work—in the act, that is, of eating the roots,—and a second supply was sent me shortly after, also caught early in the morning in the act of eating Mangolds. The damage was great, for the beetles were numerous, and was estimated as one plant in ten, sometimes one in five.

This attack is of serviceable interest as showing that this kind of beetle figured at heading, is demonstrably at times a vegetable feeder, as well as preying on insects; this latter point there was also no doubt about, as of two sent me alive, one killed its companion, and cleared out its contents.

The point of their being caught in the very early morning is also of importance, as this agrees with the recorded nocturnal habits of

* See 'Kurze Mitteilungen über Pflanzenkrankheiten und Beschädigungen in den Niederlanden in den Jahren 1892 und 1893,' von Dr. J. Ritzema Bos. Separate impression from 'Zeitschrift für Pflanzenkrankheiten,' iv. Band, 3 und 4 Heft.; also 'Biologisches Centralblatt,' xiii. Band, Nr. 7 und 8, pp. 255, 256.

† See 'Twelfth Report of the State Entomologist of Illinois, U.S.A., for the year 1882,' p. 112.

these beetles, and also points to a good reason for the cause of the mischief they do in all probability remaining unknown.

Of the *Calathus* I have no personal knowledge, but the larvæ of the *C. latus* have been recorded as doing great mischief at Wheat-roots, and in the beetles of *C. gregarius* examined by Professor S. A. Forbes, one-third of the food consisted of vegetable matter.*

PREVENTION AND REMEDIES.—In Mr. Dunstan's further communication on the subject, he mentioned:—"I thought of spreading sheepskins, or portions of them, between the rows, and so collecting the beetles with a view to subsequent destruction"; also:—"I was proposing to spread this autumn or early spring between the rows a mixture of lime, salt, and soot, with a view to preventing attack."

Any convenient adaptation of these principles would do good. For trapping, anything that might be conveniently used, such as bits of mat, slates, pieces of board, might very desirably be tried, and also sinking some broad-necked bottles in the ground with a few Strawberries at the bottom.

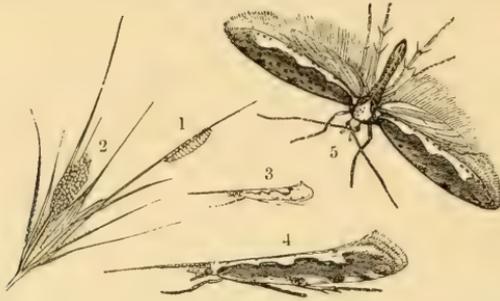
As the *Pterostichus* and *Calathus* beetles are given as wingless, it is presumable that these breed on the spot, and some search would be worth while as to whether their grubs could be found.

In the case of the Corn Ground Beetle, the grubs form "perpendicular burrows which often commence in a curve, and extend from a few inches to two feet in depth" (John Curtis); it would be worth while to investigate whether anything of this sort could be found, and (if it could be done without hurting the Strawberry-roots) it might answer, before applying the winter dressing, to stir the soil along the centre between the rows, so as to disturb or kill what maggots might be there.

* See page 109 of Report quoted *ante*.

TURNIP.

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



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

Diamond-back Moth, which was scarcely noticed in 1893, appeared again in the past season, not as a widespread pest, as far as appeared by reports received, but once again mainly at localities on the eastern sea-coast.

The record of its appearances of late years stands thus: the memorable outburst in 1891, causing almost a panic; a lesser but still injurious appearance in 1892; and in 1893 no reports, or reports of no presence; whilst 1894 has brought a repetition of some slight amount of attack, apparently much checked by weather influences favourable for growth, but at the same time (as will be seen by the following observations) to some degree helping us by confirming the benefit to be received from stimulating treatment and dressings, mechanical measures for knocking the caterpillars off the leafage, &c.

The first note regarding appearance of the Diamond-back Moth was sent me by Mr. Edward A. Atmore, F.E.S., from King's Lynn, Norfolk, on the 9th of June, as follows:—"I thought you might like to know a little about *Plutella cruciferarum*, viz., the Diamond-back Moth, this season.

"On the 1st of June I saw one specimen on the wing in a garden in the town, but last evening (the 8th), whilst collecting Lepidoptera and Coleoptera at Westwinch near this town, I found the pest flying about in *abundance* on the edge of a field of *late-sown* Turnips. As the Turnips have not been long up, I shall expect these moths to deposit their eggs upon such cruciferous plants as exist on the *weedy* border, and I noticed some little Charlock there; but no doubt other plants of the order *Cruciferae* exist there.

"Last year *P. cruciferarum* was quite a scarcity *here*, and I confess

my astonishment at finding the species so abundantly last night. Where do they come from? I can scarcely think they would lie over from 1892 in the egg or other state until *this* year."

Somewhat later in June, I heard from Mr. S. B. Burroughes, of Winton Hall Farm, Clay-next-the-Sea, Norfolk, mentioning that he had seen the Diamond-back Moth on his marshes close to the sea early in April, which, as he observed, appeared to him to favour the idea that they came over the sea from some other country. Mr. Burroughes was then having his Turnips dressed with soot and nitrate of soda to push on growth, and particularly requested information as to any better remedies, as the Diamond-back infestation had nearly ruined his Turnip crop in 1892.

On the 25th of June Mr. Burroughes, who was watching the Turnip leafage most carefully for commencement of caterpillar attack, further wrote me:—"I had one field of Turnips which were full of the Diamond-back Moth, which I dressed with nitrate of soda and soot; and that and the unfavourable weather which prevailed a few days back, has completely routed the enemy, and at present I cannot see any." Mr. Burroughes added further in the same letter:—"I have examined the under part of the Turnip-leaf very closely, but could not, up to last Saturday, find any harm done; the Turnips dressed with nitrate of soda and soot are doing extremely well."—(S. B. B.)

This report and the preceding one, it will be observed, relate to appearance of the *moths* on the Norfolk coast.

On the 11th of June Mr. S. L. Mosley, F.E.S., wrote me from Huddersfield, Yorks:—"I see the Diamond-back is very abundant here just now in the imago" (*i. e.*, moth, Ed.) "state"; and on the 27th of June the following note, sent to me by Mr. James Cooper, of Killerby Hall, Scarborough, showed presence of the attack (like those reported in Norfolk on the coast) to an amount calculated to cause serious apprehension, which in this case was amply justified.

Mr. Cooper wrote:—"We are having another attack of the Diamond-back Moth on the Turnips, and most farmers about here have had to resow their crops. I am one of such, and write to you to ask if you have any leaflets on the subject, as I wish to save my second sowing if possible." On July 10th Mr. Cooper further wrote that the infestation was on the increase, "and is clearing whole fields in these parts of the young Turnips."

On the following day (July 11th), Mr. Edmund Riley, writing from The Weir, Hessle, Hull, remarked:—"The Diamond-back Moth has also been very prevalent, especially along the coast near the sea."*

* Great damage was also reported by Mr. Riley from the Turnip Flea Beetle; but this is independent of the Diamond-back mischief, Mr. Riley being well acquainted with both attacks.

Going further north, and *still at the coast*, Mr. Andrew Balsillie, who had given great attention in the previous outbreaks to this infestation, reported on the 7th of June from St. Andrew's, Fifeshire, N.B., the presence of both moth and caterpillar as follows:—

“I regret to inform you that the Diamond-back Moth and caterpillar have made their appearance in this quarter. During the present week I was told that the moth had been observed in a field of Swedes on the estate of Strathtyrum, and on making an examination to-day, I found a number of the caterpillars, specimens of which are sent. In another field, about a mile distant, the moth was very plentiful, but certainly not so numerous as it was during the infestation of 1891. It has been fine growing weather for some weeks,—considerable warmth alternating with showers of rain, which is in marked contrast to the climatic conditions of three years ago, when the caterpillar was so destructive. It may therefore be hoped the more severe aspect of the plague will not be experienced this year; but farmers should not neglect the precautions which you previously advised as the result of your enquiry on this subject.”

Rather later on (per favour of the Editor of ‘The Farming World,’ Edinburgh), specimens were sent me of the infestation from near Anstruther, Co. Fife, N.B., by Mr. A. Gillchrist, with the observation:—“I enclose a few specimens of an insect which is very plentiful in my Turnip-fields at present. Can you tell me if they are the Diamond-back Moth?”

The localities of the above observations, it will be seen, are all on the eastern sea-coast, with the exception of Huddersfield, which is about sixteen miles south-west of Leeds in Yorkshire.

Almost the only other observations referring to anything like a district attack were from Ossemsley Farm, Lymington, Hants, a locality very near the southern coast. The first of these was sent me on the 11th of June by Mr. D. D. Gibb, as follows:—“Ten days ago I found a few Diamond-back Moths in my garden; on inspecting a Mangold- and Swede-field, I found the moths fairly numerous.” On June 22nd, Mr. Gibb reported:—“The continuous showers keep the Swede-plants in vigorous growth, and so they have not suffered from Diamond-back caterpillars; the moths are not now so plentiful either.

“The ground has been horse-hoed, then hand-hoed close to the plants, and I am only proceeding with singling where the plant is very thick, and would not do to stand much longer. The plants where thin have received a dressing of nitrate of soda, also, where singled, by a man going along each row sprinkling a little over the plants as he goes. In this way the action will be quicker than by sowing broadcast; in fact, where singling took place on Saturday, the plants left have already gained their feet, and have been but little

checked in growth. Singling alternate rows would, in the event of severe attack, probably be beneficial."

On the 30th of June Mr. Gibb noted as follows with regard to little harm being caused by the Diamond-backs, and also favoured me with a few more observations as to treatment which he found answered:—"Diamond-back Moth has been very merciful so far as we are concerned, very little damage being observable so far as I can see to Swede crops here. The crop of Charlock in the spring corn is unusually plentiful, so there is no lack of food for this pest this season.

"Where Swedes are badly attacked before singling takes place, and the crop sown on the flat, as is usual in the south of England, I have found great advantage from harrowing across the rows with common harrows, which will be found to brush a great number of the caterpillars off, then horse-hoeing can follow as soon as the plants have gained their feet. Constant hoeing, harrowing, and dressing with a forcing fertiliser, such as nitrate of soda or sulphate of ammonia, will destroy the pest if anything will, and the increased crop following this treatment will pay for the labour and expenditure in manure."

On July 26th, Mr. Gibb reported:—"The Diamond-back Moths, although still to be seen in great numbers, have been kept in check. Our Swedes show traces of attack, but seeing they are completely covering the ground with green,—the rows being twenty-four inches apart, and the bulbs the size of tea-cups,—the hurt cannot have been great. With a dry time, I believe we would have suffered considerable loss, judging by the number of moths visible and the damage caused by caterpillars during ten days of dry warm weather."

The following note, with which I was favoured in continuation of his previous communication (p. 99) by Mr. S. B. Burroughes, of Weston Hall Farm (East Dereham), Norfolk, shows, like the preceding communication, the continued presence of the moths; the beneficial effect of moist growing weather; also the beneficial effect of nitrate of soda and soot as a dressing; and also the beneficial effect of "sweeping" by means of light boughs fixed to horse-hoes and scufflers.

Mr. Burroughes wrote as follows:—"I have had the moth in every Turnip-field, but not to any great extent. As soon as I discovered them in one field of very early Turnips, I at once gathered a quantity of green broom off a heath close by, and made it into bunches, and made fast to horse-hoes and scufflers, which did much good; in fact, I did every field in that way, especially so when the caterpillars were small. One field had them rather worse; this one I dressed with nitrate of soda and soot, which had a wonderful effect, as the Turnips grew so fast that the leaves soon met across the ridges, which were twenty-four inches apart. I hope for this year we have

done with them, as the wet weather has had a disastrous effect on the moth, and stimulated the growth of the Turnip; thus, practically speaking, I think the danger is over with us.”—(S. B. B.)

A useful observation of the benefit of bird presence in keeping down Diamond-back infestation was contributed to me by Mr. Robert Ironside, of Auchlossan, Lumphanan, Aberdeenshire, on the 24th of July, when his Turnips were, to some degree, suffering from the Diamond-back caterpillars:—“As to the Diamond-back Moth, I think I have a good friend in the lapwing. A few years ago, when my Turnips were much infested with the moth, I was struck forcibly by the great numbers among them, and I have no doubt they feed on the green caterpillar; at least the infestation did not do me much harm, although I was strongly attacked. This year they have again come.”—(R. I.)

The following note, referring to attack of Diamond-back Moth (of which I had identified a specimen) as late as August in Argyleshire, and also giving a serviceably interesting note regarding kinds of sea-gulls noticed on infested land, was sent me on December 26th by Mr. W. Anderson, of Ardsheal, Ballachulish, Argyleshire:—“You were kind enough to identify a Diamond-back Moth caterpillar that I sent to you through the Editor of the ‘Farming World’ in August of this year. I omitted to mention a fact that may be of some importance. My attention was first drawn to the Turnip-field where the caterpillar was discovered by a large flock of sea-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. On examining the crop, I found the caterpillar was very plentiful on that half of the field occupied by the gulls, and I was only able to find one or two specimens on that portion of the field which was neglected by them. About eight miles south of this there was a similar occurrence, with a blighted crop, the farmer attributing destruction of his Turnips to the ravages of the gulls.”—(W. A.)

The above notes would be well worth recording if only as a means of preventing one of our best natural (and *also gratuitous!*) forms of protection being intentionally driven away.

Successive observations have been given very fully on this infestation in my ‘Report on Injurious Insects for 1891 and 1892’; but on the threatening of another outburst in June of the past year, I issued a leaflet with a detailed description of the infestation, and of the remedies which were most approved, amongst which that of nitrate of soda and soot, it will be seen by the above observations, answered well. The leaflet will be sent with pleasure gratuitously to any applicant; but I give here, to save trouble of reference, a short

description of the appearance of the moth, and also its life-history, and a few of the easily applicable and approved remedies:—

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

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

The caterpillars, when full-grown, are about half an inch long, and peculiar in shape, as they taper slightly towards each extremity; this is a marked characteristic. The colour is usually a delicate green or apple-green, but this is variable; in younger state the larva is often yellowish or greyish, with black head. When near full growth, the head is usually grey or yellowish, marked with small black dots. Each of the first three segments bears a pair of claw-feet; there are four pairs of sucker-feet beneath the body, and another pair at the end of the tail extremity. When alarmed, the caterpillar lets itself down by a thread, and swings in the air until it cares to return by the thread to where it came from.

When full-fed, which may be in about four weeks, or possibly less, the caterpillars spin their cocoons, for the most part on the under surface of the leafage of their food-plants, or on stems, or amongst seeds, or any convenient place on or near the plants on which they fed. These cocoons are sometimes a mere open net-work of white threads, sometimes thicker and of a somewhat boat-shaped form. In the former case the colouring of the chrysalis can be distinctly seen through the net; the characteristic colouring, when mature, is whitish with some black streaks.

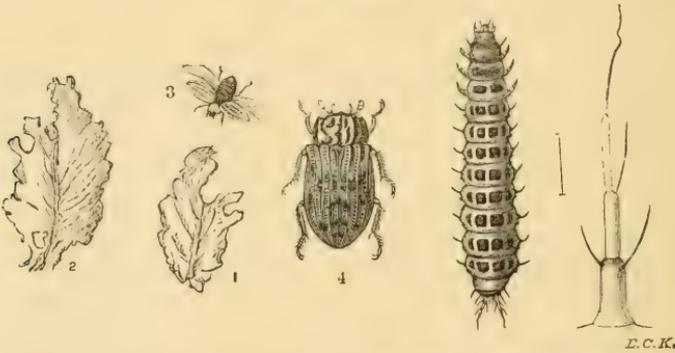
The time spent in chrysalis state may vary (as given by various writers); it may occupy rather over one to about three weeks, but there may certainly be two broods during summer or autumn, and the chrysalids from the last brood of the year remain in this state through the winter.

Of remedies, one excellent recipe sent me is that found to answer at Edenthorpe during the bad attack of 1891, namely, a mixture of 10 cwt. soot, 8 cwt. nitrate of soda, and 1 cwt. ammonia, mixed well, and sown broadcast by hand, whilst the dew was on the leaves, at the rate of 1 cwt. per acre.

The serviceableness of nitrate of soda and soot is noticed above, together with some observations as to using this application at time of singling; and Mr. Burroughes' mechanical arrangement of boughs of broom on the scufflers is excellent,—any light leafage that would remove the infestation without bruising the Turnip-leaves, of course, answering equally well.

The great point, however, is by all possible means to secure such a hearty growth as may carry the crop on past anything but overwhelming attack.

Turnip Mud-beetle. *Helophorus rugosus*, Oliv. = *H. fennicus*, Stephens.



HELOPHORUS RUGOSUS, flying, and on leaf, nat. size; also magnified (after Rye); larva, and one of pair of caudal bristles, magnified. Turnip-leaves gnawed by beetle.

The following notes refer to a recently observed attack injurious both to Turnip-bulbs and leafage, and of somewhat serious importance in districts where this special pest is to be found.

I believe the infestation had never been recorded as injurious to crops until the summer of 1889, when Mr. John Milne, of Inverurie, Aberdeenshire, favoured me with specimens of the beetles, together with the information that they were injurious to the Turnip crop in its early stages. This was very evidently the case from the condition of the Turnip-leafage sent accompanying, a specimen of which I have figured above, so as to show the damage caused by the beetle gnawing, life size, and a little magnified; and since then, specimens of the same attack have been sent from much the same district, but always in connection with damage caused by the beetles (the perfect insects), never with any reference to what might be caused by this *Helophorus rugosus* in its maggot-state, although I was on the watch for any clue that might lead to where it was to be found, until, on the 28th of

September of the past season, I received specimens, forwarded by Mr. Robert Turnbull, Inspector of Technical Education under the Aberdeen County Council, which show the presence of *Helophorus* larvæ as feeders in the upper part of Turnip-bulbs, and in the leaf-stalks, coincidentally with presence of this *H. rugosus* (= *fennicus*) on the leafage.

At present we have only notes of this "Turnip Mud-beetle" as a crop pest from localities in Aberdeenshire or its neighbourhood; but as under its synonym of *fennicus* this kind is recorded as found at various places in Kent, also as having been found in Hertfordshire, Norfolk, near Carlisle,* &c., though "not common," we might find, if attention was directed to the subject, that these maggots are the cause of some of the tunnellings in tops of Turnip-bulbs, of which the reason has not yet been made out.

The history of the infestation, with description of the beetle and maggot, and habits, so far as we know them at present, stand as follows:—

The beetles are about a quarter of an inch long (see figure, natural size, at p. 104); when magnified (and carefully cleaned from the mud or dirt, with which it is one of their characteristics to be often covered), they will be found to be of various tints of a rusty or rusty-reddish colour; the wing-cases greyish or ochrey, with scattered dark spots; the legs and horns (which are somewhat clubbed at the end) pale. The thorax (body behind the head) is slightly waved at the sides, and has five grooves, more or less forked and interrupted, running along it, and the wing-cases are punctate-striated, the spaces between being raised in a smooth clean narrow ridge. By the presence of this line running along the wing-cases, this kind may be especially distinguished from the *H. aquaticus*, which is noted by Stephens (see reference below to 'British Entomology') as being "common in every stagnant pond and ditch throughout the Metropolitan district, and, I believe, in most parts of the country."

In the notes given me in 1889, by Mr. Milne, of the habits of these beetles, he mentioned amongst other points that he had "observed Turnip-fields attacked at the side next a former Turnip-field here and there throughout this part of the country" (Inverurie, Ed.) "for over thirty years. It is most seen in crofts (small farms) where the lots are in narrow stripes; in some cases I have seen the portion of a lot next the last year's Turnip lot quite half-eaten. The mischief is done when the plants are small."

Some slight amount of observation of presence of the beetles was sent in following years from one or two localities in the neighbourhood

* See Stephen's 'Illustrations of British Entomology: Mandibulata,' vol. ii. p. 111; also, by the same author, 'Manual of British Coleoptera,' p. 84.

of the above, but it was not until the 28th of September in the past season (1894) that I had information of maggots, which turned out to be *Helophorus* larvæ, being found working in the top of Turnip-bulbs, and in the leaf-stalks. These were forwarded to me by Mr. Robert Turnbull, Inspector of Technical Education under the Aberdeen County Council, amongst other specimens taken from Turnips, with the remark:—"The smaller grey larvæ, with four rows of black spots along the back and sides, are evidently of a beetle. . . . They eat the surfaces of the Turnips and leaf-stalks into holes, and also burrow into the leaf-stalks. During the past two years, this mode of attack has been very common, and the farmers complain that rain gets into the holes thus made in the tubers, causing decay to set in."

Some delay occurred in procuring the further supply of specimens; but early in November, examples of the injured Turnips, together with specimens of the maggots from them, or still within at the top of the bulb, and also some of the beetles, that is, the *Helophorus rugosus*, or Turnip Mud-beetle, were forwarded to me (per favour of Mr. Turnbull) by Mr. Peter S. Cowie, of Netherton of Delgaty, by Turriff, Aberdeenshire, the observer from whom the previous samples had been sent.

On examining the bulbs sent (on the 12th of November), I found the maggot-burrow at the top of the Turnip running (not as a clean even gallery, but roughly gnawed and uneven) mainly round the base of the central growth of leaves. As far as I saw from samples sent, the injury was just under the bark, but it sometimes went a little lower down, and was sometimes a burrow little more than the width of the maggot, sometimes two or three times its width from the Turnip being more eaten away. This, of course, was causing brown decay, running down to some degree into the substance of the Turnip, and likewise a sickly growth of the crown.

By comparison of the different supplies of specimens sent me in November, I found the larva, or maggot, then, when in movement, measured up to three-eighths of an inch in length; in shape it was rather narrow, cylindrical, but largest from about the eighth to the tenth segment, and narrowing thence gradually to the head, more rapidly to the obtusely-pointed tail, which bears a pair of three-jointed appendages (cerci), each with a delicate seta or thread-like termination (see figure, much magnified, p. 104).

To the naked eye, the little grubs appear merely as pale and shiny, with a dark head, and dark markings above. When magnified (see figure), the head appears of a somewhat chestnut-grey colour, and furnished with strong chestnut-coloured jaws; narrower than the succeeding segment, which is broadly marked above by a transverse grey band, darkest at fore and hinder edge; the two succeeding segments have each a much narrower transverse band, divided along

the centre by a light line, the division hardly showing on the foremost of these two segments.

Along the rest of the abdominal segments is a double row of squarish grey spots, or rather a short transverse band across the back of each, divided along the middle by a pale line, and below, on each side, a row of smaller grey spots.

On submitting some of the larvæ for the benefit of trustworthy identification to the Rev. Canon W. W. Fowler, of Lincoln, he was good enough to write me in reply:—"The larva is without doubt that of the *Helophorus*"; and he also sent me the description of the *H. aquaticus** (a species allied to *H. rugosus*, but of more aquatic habits), and Schiodte's figure, that I might see from them that the larva was evidently that of a *Helophorus*, and from the accompanying circumstances clearly that of *H. rugosus*.

What we want now to complete the life-history, is where the grub changes to the pupal state. Presumably this takes place either in its food-plant, or in the earth by it. Also it would be of serviceable interest to know how the beetles contrive to make themselves so exceedingly muddy. In the description given by Prof. Westwood of the habits of the family of the *Helophoridae*,† he says:—"They inhabit ponds and ditches, creeping slowly about the roots of aquatic plants, or occasionally coming out of the water, and walking upon the muddy banks, covered with dirt, whence the name of the typical genus; they also often fly about in the hot sunshine." Conjecturally, the Turnip Mud-beetles, though partly infesting Turnips, also spend a part of their time in mud, or muddy water; but this kind is obviously not of so aquatic a nature as some others of the family, and for the sake of the Turnip crops more information is very desirable.

The following notes, taken from carefully detailed observation, for which I am obliged to Mr. Peter S. Cowie, of Netherton of Delgaty, by Turriff, Aberdeenshire, show how much mischief is done by the grubs; also the method and position of the attack, and the appearance of the infested crop. With the observations, Mr. Cowie forwarded specimens of the beetles and of the maggots, and some examples of attacked Turnips, with the remark:—"I have also sent a few cuttings from Turnips, one showing the perforated skin healed up again, and another with a cavity right under the shaw; I find a great many with this, having the skin all green like the outer skin. The other shows the leaves all gone, being eaten away by the maggot."—(P. S. C.)

Mr. Cowie's observations, which are given in careful detail, begin with mention of circumstances of maggot-attack in 1893. In that

* 'British Coleoptera' (Fowler), vol. i. p. 334.

† See 'Introduction to Modern Classification of Insects,' by J. O. Westwood, ol. i. p. 121.

year (he mentions) he sowed his Swedes and Early Yellows in the third week of May, "which would be considered early even in this early district. The season was dry. The soil light and dry."

The second portion (the lesser half of the crop) was sown in the second week of June, there being thus about three weeks between the sowings. "Both sowings came well to the hoe (thinning out), and nothing unusual was to be seen at that time. But at the second hoeing, when the tubers, or bulbs, were about the size of a man's thumb, the shaws became spotted,—pale yellow spots all over the leaves from the size of a sixpence to the size of a penny. The leaves also grew in a kind of confined cluster, rising straight up from the bulb thus (sketch given), having a hard and unhealthy appearance, and also curled in over the edges."

This, Mr. Cowie mentions, only happened to the Yellows of the first sowing; the Swedes of the first sowing, and the Yellows of the later sowing, remaining healthy throughout.

On examining the unhealthy Turnips, Mr. Cowie found maggots like those reported on after in 1894; these had bored the bulbs of the Turnips all round close at the surface of the soil; the bored holes in some of the Turnips were so near together that not a particle of healthy skin remained. Mr. Cowie noted:—"I did not think of looking among the leaves, and at that time I thought the maggots were hatched on or in the soil; many of the Turnips died out, leaving the ground with large empty spaces, and the Turnips that remained were small 'cryned' things.

"The spotted leaves were all off them by the end of July, and a tuft of young tender leaves had come on by the middle of September, when I commenced to use them; they were not half a crop. Manured per acre with six cwt. of J. Milne & Co.'s slag Turnip-manure, with half cwt. sulphate of ammonia, sown separately of course, with a good dunging.

"This is all I can say of 1893. In 1894 the weather broke, and it became wet and rainy before I got the soil cleaned of weeds (the soil is a sandy loam, with gravel subsoil), consequently it was into the month of June before I got any Turnips sown. I sowed Beck's Early Yellow on the 5th of June, also twenty drills of Golden Yellow; on the 7th of June I had twenty drills of Swedes between them. The Beck's Yellow came very slowly to the hoe, or thinning out, and they had a pale-green, hard, ragged, unhealthy appearance even at that time. They came away slowly, but at the second hoeing I observed that the leaves had the same confined upright appearance, with the edges curled in over, but no appearance of the spots on then, which they had the previous year. The leaves at a distance had the appearance of Swedes, dark bluish green; I examined the bulbs, and was

surprised to find scarcely any boring in those which had an unhealthy shaw; I pulled up a few of them to see the roots, they were all right, no finger-and-toe to be seen; I then broke away the leaves, and found the enemy under cover close down at the *roots* of the leaves (or rather where they leave the bulb), and a great many of them in the centre of the shaw, eating up the young growing leaves. In fact, the young leaves never got grown, they were eaten as fast as they grew. I found the maggots of different sizes, I suppose being of different ages, young and old. I found sometimes as many as a dozen in one shaw, some shaws fewer; but I did not find a single Turnip without them among the Beck's Early Yellows. The summer was wet, but they seemed to thrive either in rain or sunshine.

"This year" (1894, Ed.) "they have remained more in the shaw than the bulb, and the crop is better than last year's crop; it is grown on heavier soil. No second growth of young tender leaves this year; the first leaves are almost gone, and the bulbs nearly bare; what are left come away in your hand when pulling.

"The twenty drills of Aberdeenshire Golden Yellow sown on the 7th, two days later, is the best crop on the field; I would say they are a full crop. The whole of the field, with the exception of the Beck's Early Yellow, are a good crop, and free from the pest."—(P. S. C.)

Mr. Cowie also observed, in the above letter of November, that they are observable much earlier in the season than at the date of writing, and that he thinks they have the infestation more or less every year.

Looking at the above observations, it does not appear as if moderate difference in date of the first sowings made a difference in attack, as in 1893 those early in June escaped, and in 1894 some of them were infested. Nor does weather appear to have influence, as in 1893 the "season was dry," and in 1894 it is noted that the weather broke, and became wet and rainy to a degree to cause sowing to be delayed. I do not see that anything can be considered proved as to one kind being more subject than another to attack, excepting that both in Mr. Cowie's observations, and in those sent me by Mr. Milne in 1889, I do not find mention of Swedes being injured.

But with regard to prevention of recurrence of attack, something may, I think, be very usefully gathered from some of Mr. Milne's *repeated* notes, with which he favoured me in the year above referred to. He mentioned:—"When a field is sown in Turnips alongside one that produced Turnips the year before, not unfrequently a few of the drills *nearest to the field which grew Turnips the year before* are destroyed by this insect.

"I have observed Turnips *attacked at the side next a former Turnip-field* here and there throughout this part of the country for over thirty years.

“It is most seen in ‘crofts’ (small farms) where the lots are in narrow stripes; in some cases I have seen the half of a lot *next the last year’s Turnip lot* half eaten.

“They do not seem to fly much.”*

This species is obviously much less of a water-frequenting kind than others of its family or genus, and it seems very likely that the grubs may turn to chrysalids in the earth, and winter there, ready to change to beetles in spring.

For remedial measures, probably the usual dressings for Turnip Flea-beetle would do good; as, for instance, the well-known mixture in proportions of lime and gas-lime, each one bushel, thoroughly mixed and powdered up with soot, ten pounds, and sulphur, six pounds. This applied early in the morning, if the beetles are then on. Nitrate of soda applied, as noted at p. 100, by hand on each Turnip would also help to push on growth, and very likely help to poison the little maggots before they got down *into* the leaf-stalks and bulb.

How far this attack may be found in southern Britain we do not as yet know, but the beetles certainly are to be found, and where Turnips may be noticed in the coming season with yellow-patched leaves, with edges turned in, and the central growth stunted, and forming an upright compressed mass, I should be very glad of specimens for examination. From a few Turnips sent me last year, I think the infestation might very likely be found doing harm in the neighbourhood of Norwich.

Springtails. *Smynturus luteus*, Lubbock, and *S. niger*, Lubbock.



SMYNTHURUS NIGER, magnified, nat. length one-twenty-third of an inch.†

* See ‘Thirteenth Report of Observations of Injurious Insects,’ by E. A. Ormerod, p. 100.

† Figure copied, with thanks, from Plate VI. of ‘Monograph of Collembola and Thysanura’ (Ray Society), by Sir John Lubbock.

The following notes refer to observation of a minute insect-like infestation, rarely noticed with us, as hurtful to the leafage of field crops, although one or more kinds do much harm at times in Cucumber-frames to the young plants by gnawing the surface of the leaf, and they are mischievous also out of doors to "succulent roots and plants, especially where anything has happened to diminish the vitality of the plant."—(Andrew Murray.)

Samples of the infestation were sent me in July of the past season from Lumphanan, in Aberdeenshire, as being then doing much harm to Turnip crops in the neighbourhood, and on examination the specimens proved to be (scientifically speaking) of the genus *Smynturus*, of the order *Collembola*, more popularly known, by reason of their remarkable jumping powers, as "Springtails."

Until the past season this kind has never been brought (as a field-crop attack) under my own notice; still they may need looking after, as very similar species were drawn attention to many years ago by John Curtis in his 'Farm Insects' as injurious by eating the cellular tissue of green leaves. His description (just taking the main points) of the species he noticed—as being not bigger than a small grain of sand, with a large head attached by a slender neck, and furnished with slender four-jointed antennæ; the trunk and body united so as to form a globose mass, with a forked tail (or process) doubled under it for leaping, and six rather short legs for walking—gives a fairly intelligible idea to begin with of the general appearance of these leaping Springtails under a powerful magnifier.

The figure at p. 110 shows one of the *Smynthuri* enormously larger than life, and at rest, so that the leaping-fork, being doubled away beneath it, is out of sight.

The first note regarding this infestation was sent me on the 5th of July by Mr. Robert Ironside, from Auchlossan, Lumphanan, Aberdeenshire, N.B., as follows:—"My Turnips and others in this neighbourhood are being a good deal damaged, not only by the Turnip Flea, but by something else, which I never observed before; I enclose specimens of plants as attacked. There is also enclosed an insect which I fear has something to do with it. It is very active in its movements."

On these plant specimens I failed to find any infestation excepting caterpillar of Diamond-back Moth still in very young state, and on writing about it to Mr. Ironside he replied that this caterpillar was present, but remarked further:—"That was not the pest I wished to bring under your notice. This season, and on certain fields in this neighbourhood, the young plants were eaten; not only the first two leaves were eaten, but the rough leaf was also attacked, by small (*perhaps*) beetles, at least ten times less than the ordinary Turnip Beetle; these mostly being a dirty yellow colour, but there were also

black ones. . . . They jump on being approached, and so are difficult to get, or I might have sent you a specimen.

“So numerous were they on some fields, that as one approached them they rose before one like a little cloud. They have all but disappeared now” (July 24th.—E. A. O.). “They may have been here in former years, but I never observed them, and they could not have done so much harm without being noticed.”

Still (from the difficulty of capturing these minute leaping creatures) I had no specimens; but on the 30th of July, Mr. Ironside forwarded me a good supply, captured by placing the open mouth of a phial over the Springtail, and with these he wrote further:—“I send by this post a few specimens of the pest we were concerned about among the Turnip plants. I got them all below the leaf, but I saw a few on the upper side, which suddenly jumped away on my approach. They are not nearly so numerous as they were, and not quite so keen, as I had no difficulty in approaching them. I put the mouth of the phial over the insect, and touched the top side of the leaf, and they jumped right into the bottle. . . . I have sent you leaves of the Swedish and of the common Turnip to show you the dishealth existing.”

Later on, that is, on the 20th of August, Mr. Ironside wrote me that he had been making several examinations of the Turnip-leaves in order to feel *certain* that it was the Springtails that were nibbling the under side of the leaf, and now considered that it was these creatures that were nearly the whole cause of the mischief.

Mr. Ironside remarked:—“It is not always one can catch them at their work, as one cannot see them without taking the leaf up; and they are thereby apprised of your presence, and the forked tail promptly used. I am also strongly of opinion they thrive in moisture (and quite unlike the Turnip Beetle in that respect). I said to you in a former note that the Springtails were disappearing; I now find they are not, but are present in all sizes; this makes me think that the extremely wet weather we are having is conducive to their existence.”

The specimens sent me were quite certainly of the genus *Smynturus*. This genus is distinguishable by the globular form of the creatures, also by the antennæ (or horns) being four-jointed, with the terminal segment *longer* than the others.

With regard to the precise species, the specimens sent me agreed so well in colour, shape, structure, and measurement (so far as I could follow up the points with a quarter-inch microscopic power) with the description given by Sir John Lubbock* of the *Smynturus luteus*, Lubbock, that I do not see any reason to doubt their being of this kind.

* See ‘Monograph of Collembola and Thysanura,’ by Sir John Lubbock, Bart., p. 108.

The colour was pale yellow, or sometimes inclining to a more orange tint. Length variable, but about (or commonly less than) the thirty-second of an inch. Head with eyes on a black patch. Antennæ four-jointed, each segment being (as mentioned by Sir J. Lubbock) nearly twice as long as the preceding. The terminal segment, when it had lain for some time in glycerine, and was examined by a high power, appeared to be composed of twelve rings, the four lowest soldered together, but slightly segmented, especially between the second and third; the following five rings distinctly segmented, smallest at the base, and enlarged at the top of each with a few very noticeable somewhat aborted hairs, and the terminal beads, which might be considered either as three, or as two with a cross marking, more or less soldered together, and lessening to the apex. In some specimens the open beading scarcely showed at all. This appeared to depend very much on the condition of the specimen and the fluid used for examination. The terminal lamellæ of the branches of the springing-fork were elliptical, in a moulted-off skin almost oblong.*

Specimens of the black kind of Springtail, mentioned by Mr. Ironside as being observed together with the yellow kind, might be conjectured to be the *Smynthurus niger* figured at p. 110, but of these I did not receive specimens, and therefore cannot be sure.

The genus of *Smynthurus*, with about twenty-one other genera included in the division of "Springtails" by Linnæus, and now divided into *Collembola* and *Thysanura*, are doubtfully classed as true insects. They resemble insects in being possessed of a distinct head furnished with antennæ, or horns, commonly with mouth-parts much like those of biting insects; of a thorax with three pairs of legs, and of an abdomen, globular or linear as the case may be. But besides many other points unnecessary to enter on, they differ from typical insects in never possessing wings, and also in often (*not always*) possessing an apparatus known as the leaping-fork, which may be generally described as much resembling a pair of compasses, with an enlarged longish top, and with the legs sometimes fine and straight, and tapering gradually to the minute lamella or appendage at the tip, sometimes variously thick and curved. This apparatus, when at rest, is doubled forward beneath the abdomen, but can be suddenly unloosed

* The only other of the eight British species of *Smynthurus* to which the specimens sent might appear on slight examination possibly to belong was the *S. aureus*, Lubbock. But on careful examination, I did not find that the samples sent me were pale below, nor did I detect a double black spot in front of the antennæ, nor was the terminal joint of the antennæ with no distinct evidence of segmentation, which is the case with *aureus*, nor did the form of the two branches of the leaping-fork, and of the lamellæ at the end of each branch, correspond with the figures given by Sir J. Lubbock of those of *S. aureus*.

with a power which sends its owner flying through the air with the springing-tail extended behind it.

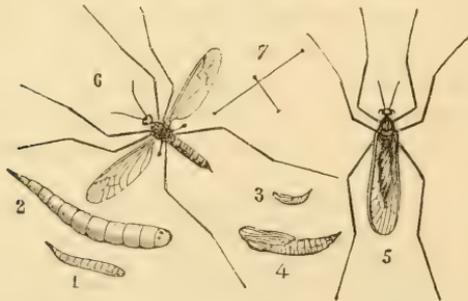
This attack is so rarely observed in field cultivation with us, that it would hardly be worth noticing, excepting that possibly from its minuteness it may be overlooked as connected with the real mischief which it *can* cause; therefore it seems desirable to give enough of the microscopic details to recognise it by.

The Springtails propagate by laying eggs, and the young, when first hatched, are stated to have the six legs well developed, and to "present a general resemblance to their parents, differing, however, in proportions, colouring, and, in some genera, in the form of the antennæ."—(Lubbock.)

Some, or others, of the different kinds frequent the most different kinds of localities; some float by preference on water, or on drainings from hot-beds, and some are found in dry rooms. Some are common amongst grass; some, as I have seen them, collected in myriads on kitchen-garden paths, as if patches of gunpowder had been spilt there; and rich soil, or decaying vegetable matter lying near the surface, is considered to have special attractions for some kinds.

If they were found to be seriously injurious in field cultivation, the ordinary dry mixture of lime with sulphur and soot, or other Turnip dressings, thrown as well as could be managed upwards at the under side of the leaves, or wherever the Springtails might be found to collect, would be almost sure to do good, and so would soft-soap syringings or washes. But at present there does not seem any reason to fear crop trouble from this cause, and the above note is given to preserve the record of occasional presence.

Winter Turnip Gnat. *Trichocera hiemalis*, DeGeer.
Thaw Gnat. *T. regelationis*, L.



TRICHCERA HIEMALIS.—1 and 2, grub; 3 and 4, pupa, natural size and magnified.

The little gnats, or *Trichocera*, of which one kind is figured above, are bred from small maggots to be found in different kinds of decaying

vegetables, and those of the *T. hiemalis*, or Winter Turnip Gnat, are more especially to be found in decaying Turnips. The gnats are very often to be seen in winter (or from October onwards) floating or dancing up and down in the air, in great numbers at one spot, in fields or gardens; and appearances of the Winter Gnat are supposed to be so much influenced by weather that this insect was one of the kinds selected by the Meteorological Society for report in their yearly observations of natural history phenomena. I have often watched the numerous parties of what appeared, without special examination, to be the common Winter Turnip Gnat; but the *T. regelationis* (the Thaw Gnat, as the scientific name may be rendered) is so exceedingly like the *hiemalis*, that I think it very likely both kinds might be present.

So far as is shown by the regularly recorded habits of the Winter Gnats, the infestation cannot be called injurious; rather the reverse, for the maggots, living in putrid and moist parts of the Turnip-bulb, help to get rid of foul useless matter. But though their history was made out many years ago, it may be worth while to give a few observations, as their presence is apt to be confused with several common Turnip attacks, or fungoid diseases, which they have *nothing to do with*.

The maggots are of the shape figured at p. 114, legless, cylindrical, tapering gradually to the head end, which is very pointed, and largest towards the tail, which is blunt and rounded, *not pointed*. The colour yellowish, and the length not quite half an inch. These are to be found in small numbers, or rather parties, in rotten parts of the bulb.

The chrysalids (see figures) show the shape of the wings, and to some degree other parts of the insect maturing, within the thin outer film. The little gnats are brownish-grey, the thorax (body between the wings) with four brown or fuscous stripes; the two wings iridescent and glassy, of a yellowish tint, and *spotless*, longer than the body of the gnat, and lying flat when at rest. The legs long and slender; head small and globular, with mouth forming a little beak, slender neck, and two lateral black eyes, and antennæ, or horns, long and thread-like.

The "Thaw Gnat" is almost precisely like the above, excepting in having a brown spot on each wing; but I am not aware of this kind having been definitely noticed as bred from rotten Turnips, until in the course of October of 1893, the attention of Mr. W. Sims, of Gourdas, Fyvie, N.B., was attracted by the large number of decayed roots in the Turnips which he was gathering, and on examination found these to be much infested by small maggots. Without entering at length into Mr. Sims' observation,* I may mention that of these larvæ some still remained unchanged to gnat condition at the end of

* See 'Banffshire Journal' for Tuesday, May 1st, 1894.

April of the past season, and as the species was not known to the observers, specimens were sent to myself for identification, which proved to be of the *T. regelationis*, and, as the matter is of some interest, I give a part of my reply to the Editor of the 'Banffshire Journal' (see number for May 8th):—

“With regard to the species, this on the first glance appeared to be the very common *Trichocera hiemalis*, well known as frequenting rotten Turnips, of which an excellent description and figure is given in Curtis's 'Farm Insects,' p. 137.

“On turning, however, to the long and minute descriptions of different species of *Trichocera* given in the 'Fauna Austriaca' (Diptera) of J. R. Schiner, vol. ii. pp. 547, 548, I found it noted that the *T. hiemalis* is like another species of *Trichocera*, namely, *T. regelationis*, in colouring, but is distinguishable from it by the wings of the *hiemalis* being quite clear and transparent, whereas the wings of the *regelationis* have a slight darkish spot on the little cross-veins.

“This small greyish spot I found was present; but as mere matters of colouring are sometimes variable, I submitted my doubt (together with your specimens) to Mr. R. H. Meade, of Bradford, one of our chief authorities on the *Diptera*, and I have heard from him in reply, as follows:—

“‘The flies that you sent me are the *Trichocera regelationis*; the wings of *T. hiemalis* are quite clear without any spot. These species are sometimes very difficult to determine, for the nebulous patch upon the vein is sometimes much more distinct than at others.’”

In regard to method of life of these gnats, it has so long been recorded on trustworthy authority that they are an infestation of rotten vegetables, that there does not appear any opening for doubt, and I believe that the matter could not be better put than in the following few words of Prof. M. C. Potter, of the Durham College of Science, when consulted regarding this infestation:—“There can be no doubt that its grubs merely live in the rotten Turnips, acting as scavengers, and are in no way responsible for the rottenness; but that they may aid in the work of destruction is probable, for flies in various ways disseminate the spores and reproductive bodies of fungi.”

And the following sentence from the same letter by Prof. Potter is well worth attention:—“The best way to combat the insect and fungus infestations is to thoroughly destroy all rotten and diseased plants. To leave them lying about, or to throw them to manure-heaps, is merely to extend their ravages; and farmers will find it more economical to destroy the germs of disease in this manner, than to have a large part of their crops destroyed, or to spend money in remedies which have a very uncertain effect.” *

* From 'Banffshire Journal' for May 22nd, 1894.

Note on Prevention of Carrot Fly attack received after the early part of this Report was in type.

In the course of various communications with which I was favoured on matters of insect prevention by Mr. Robert Turnbull (Inspector of Technical Education under the Aberdeen County Council), he was good enough to give me the following observations of success in preventing loss from Carrot Fly Root-maggot by use of waterings of soft-soap and paraffin oil mixtures, largely diluted with water. These I was not able to introduce in proper alphabetical order of crops, but still do not like to omit what may be very useful, and therefore insert them here as a note with this explanation.

Carrot-maggot, as is well known, is the small legless yellowish grub, about a quarter of an inch long, of the *Psila rosea*, or Carrot Fly, a greenish-black two-winged fly, with a rusty- or ochre-coloured head, and ochre-coloured legs; and the attack is started by the Carrot Fly getting down through the earth by means of cracks, or otherwise, close to the Carrot-roots, and there laying their eggs, from which the maggots hatch, and gnaw galleries into the Carrot, thus causing the damage commonly known as "rust" from the peculiar colour. With quite young Carrots the attack is chiefly at the lowest end of the root.

Measures of cultivation, manuring, dressing, &c., calculated to keep the soil in such condition as will not admit the fly, and management at time of thinning, which is the most hazardous of all periods to the crop, have been given in previous Reports on the authority of good Carrot-growers; but in the past season I received the following communication from Mr. Robert Turnbull, Inspector of Technical Education under the Aberdeen County Council, 7, Chanonry, Old Aberdeen, N.B., on the subject of an application which had been so generally found useful as a preventive of "rust," that I give it as sent me. I may mention that I have been indebted for other good communication and collegueship in work to Mr. Turnbull, and it will be seen that in this case we are also indebted for consideration of the subject to Mr. Malcolm Dunn, Horticultural Superintendent, Dalkeith Palace, the value of whose advice can hardly be over-estimated. Mr. Turnbull wrote me on the 25th of October as follows:—

"In your 'Text-Book' I just learned of the efficacy of paraffin against certain insect-attacks, and as you mentioned Mr. M. Dunn, of Dalkeith, who is one of my fellow-councillors of the Edin. Bot. Soc., I took occasion to consult Mr. Dunn in person about the use of paraffin; and after advising many people in Aberdeenshire to use it for the Carrot crop, I find that good crops of Carrots can now be got, where formerly they always succumbed to the maggot-attack.

“The following is the recipe I give:—Pour two tea-cupfuls of water into a pan, and add a heaped table-spoonful of soft-soap, then boil; remove the pan, and pour in a tea-cupful of paraffin; let the mixture simmer for five minutes, and keep stirring all the time; cool and bottle. This quantity is sufficient to water a bed of Carrots in a cottage garden. To use the mixture:—Add the above quantity to two gallons of water in a watering-can which is fitted with a rose. Water 1st after sowing, 2nd after germination, 3rd after thinning. If wet weather should prevail, then water a few more times.

“The following gentlemen have used the emulsion on my recommendation, and with uniform success:—

“1. Rev. J. Rae, Congregational Manse, New Deer, by Aberdeen.

“2. Rev. M. C. Thorburn, E.C. Manse, Lumphanan, Aberdeen.

“3. Rev. R. McLean, School-house, Lumphanan, Aberdeen. This gentleman has tried Carrot-growing but without success for twenty-three years, and this is the first year he has got a healthy crop. He used the emulsion as I directed.

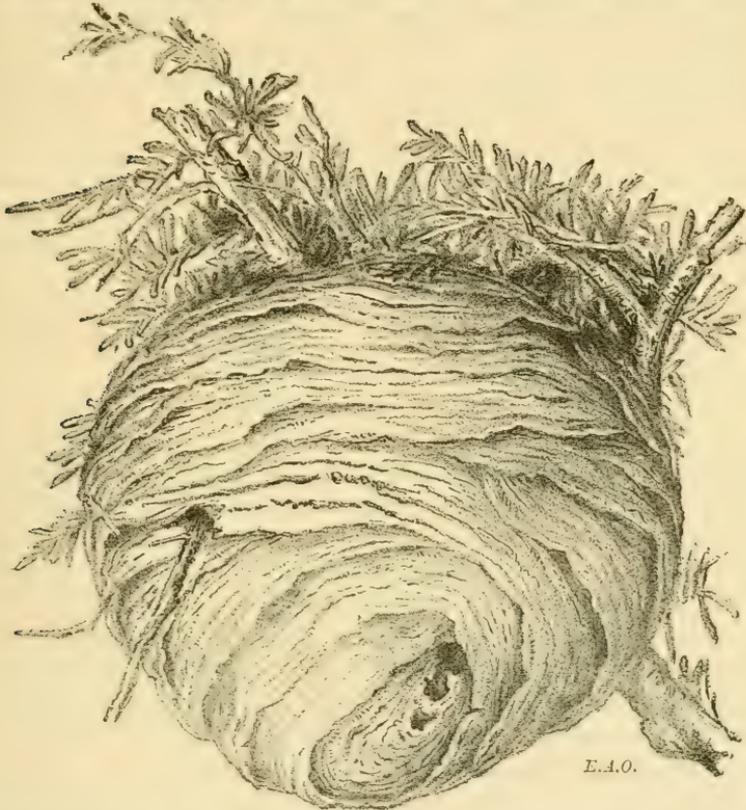
“4. W. A. Clark, Esq., M.A., School-house, Slains, Aberdeenshire. Also the first healthy crop he has grown.

“Those gentlemen have reported to me many similar examples in their parishes and neighbouring districts.”—(R. T.)

I would certainly suggest to those who are troubled with “rust-maggot,” that they should try the above recipe, and I should be glad to have information of results. From the nature of the mixture it might reasonably be expected to do much good, and where such is the case, knowledge of an application which can be given when the need for it arises, is a general benefit.

WASPS.

Ground-building and Tree Wasps. *Vespida* of various species.



Nest of Tree Wasp, after sketch from original specimen by Editor. Dimensions eight inches across by seven and a half deep.

The year 1893, it will be remembered, was remarkable for a prevalence of Wasp presence in many parts of England, and some parts of Scotland, amounting to a very serious trouble, from losses to fruit-growers by consumption of their crops; inconvenience and sometimes dangerous accident both to men and horses in field work from onslaughts of enraged Wasps out of ploughed-up or disturbed nests; also, indoors, unbounded inconvenience from intrusion of the pests, even into the food in the act of passing from the plate to the lips, and in shops where available materials for their use was procurable, unceasing depredations during the day for their own benefit, or transportation to the home nurseries.

The details of the "Wasp-plague," as it was truly described,

together with requisite information as to habits, and means of prevention of the pests by trapping, &c., or wholesale destruction of their colonies, was given in my 'Seventeenth Report,' at pp. 111—140.

Following on the "plague," as matter of course, was much popular alarm as to a repetition of the trouble, notwithstanding the exceptionally great Wasp presence being obviously accounted for by the exceptionally suitable condition of weather in the early part of the year for propagation, and with return of spring much appeared in the papers as to numbers of Wasps captured here or there under influence of payments at so much per Wasp or the quantity named.

So far as first observations of Queens in natural circumstances which were sent to me showed, they could not be said to be particularly early or unusually numerous. About the first observation I received was from Mr. H. L. Leonard, of Preston, Hull, who noted on the 2nd of April:—"I saw a Queen Wasp to-day for the first time this year. Considering the lovely weather which we have had throughout March, I wonder I have not seen one earlier."

Mr. J. Chambers writing from Toy's Hill, Brasted, Kent, on the 3rd of April, mentioned that a labourer in loading peat that had been stacked last summer found four Queens (and killed them) in loading one cartload from this stack on Brasted Chart, and also that the vicar had given him one of three Queens caught on the previous Sunday in the "iron-room." This specimen, which was sent to me, was a Queen of the widely-distributed species *V. germanica*.

On the 10th of April, Mr. Edw. Goodwin, of Canon Court, Wateringbury, near Maidstone, remarked:—"Queen Wasps are about as numerous as usual, and with the present favourable weather will probably establish nests."

In this house (Torrington House, St. Albans) a few Queens were seen or killed from April 10th to 17th, but not more than four noted; the three of these which I examined were (respectively) *V. vulgaris* and *V. germanica*.

From Quinton House, Stratford-on-Avon, Mr. T. C. Hiatt's notes of the 2nd of May showed a troublesome amount of Hornets, but no great number of Wasps:—"I put my dressed bottles (four in number) out in April, and have caught twelve Queens in two already. Also a lot of Hornets are about."—(T. C. H.)

As the season advanced, a few notes were sent me of collection of Queen Wasps being made; but without information accompanying of the extent of the area in which these were captured, or any data to help towards comparison with amount of presence of Queens in previous years, we learn little from the captures excepting that a certain number of dead specimens of the pests have been submitted for payment, and from the condition of some scores or hundreds which

have passed through my hands, I am not by any means sure that many of these had not been searched out of holes and corners in dead condition.

A Queen Wasp on the wing in April, or hybernating preparatory to flight, is glossy and bright, and would last for some time without becoming faded and discoloured, so much shrunk as by no means to convey the impression she was a Queen at all, and also so putrid as for the abdomen to break in on touching. It may be worth while to



VESPA VULGARIS.—Largest specimen, Queen, or female; specimen to left-hand with long horns, drone, or male; right-hand specimen, neuter, or worker.

draw attention of those who are not accustomed to examination of insects to these points, and also to note that the mere number of Queens paid for is not a sure guide as to the number got rid of.

Therefore, amongst the various observations received, the only one which seems of special interest is the collection made by Mr. H. Foard Harris, of Brooke House, Fleet, Hants, which suggests that, where wished, and where there could be some confidence that the Wasps brought in were from that special neighbourhood, identification of species would give some interesting information as to coincidence of occurrence of special kinds with special kinds of soil and surroundings. The exceedingly liberal reward offered by Mr. Foard Harris brought in a very large reply in the shape of dead Queens; in the words of my contributor, in agreeing with me that the sum was large, he remarked: "But the plague here last year was so 'awful' that we would do anything to avoid another." As, however, he did not feel certain that all brought in were Queens, he forwarded a large number to me for examination. They proved to be right in this respect; but in turning them over, I was so much struck by the preponderance of specimens of "*V. rufa*," which had never been a common kind in localities where I studied Wasp life, that I ventured to submit some of the specimens to Mr. Edw. Saunders, F.E.S., of St. Ann's, Woking, for benefit of his skilled identification. Mr. Saunders kindly replied:—"All the examples of Wasps you sent are Queens. *V. rufa* is always common

round us, and I am not surprised at the proportion you mention. I think, however, it is probably commoner in our sandy districts than elsewhere." Three other species were present in the few specimens I forwarded.

It is of some interest to note that of the Queens sent me, some were more or less coated with white. This, it was explained, was from the lime under the Gooseberry-bushes, amongst which they had fallen. Is it possible that in these instances the Queens might be doing us good by searching out Red Spider? On the 28th of April, Mr. Foard Harris noted:—"My gardener tells me that during the last few days, most of the catches have been on the Lilac-flowers."

So far as I can judge from reports of 1894 regarding Wasp-attack, there was early in the year much popular fear of a new attack, and attention was widely directed to destruction of the Queens; and then (as a widespread grievance at least) the matter appears to have died away. As usual, there was some amount of Wasp-presence, but in contrast to the widespread mischief and trouble of 1893, the absence of reports in 1894 is worth record to show that the outbreak of one year is by no means necessarily followed by a similar one in the year following.

APPENDIX.

IN the course of last autumn, circumstances arose which made it desirable to give in connected form such an abstract of the main points of information regarding Warble Fly, contributed to me by British observers, as would place all that is requisite regarding the history of the infestation as it has been observed in this country, together with proved means of prevention and remedy, in a conveniently available form before those practically interested.

In ordinary course, this would have been published in my present Report, but the issue being required at once, this same account is now inserted in the form of an Appendix, in order that the results of the long series of observations, beginning in 1884, may not be absent from the series of my Annual Reports.

OBSERVATIONS
ON
WARBLE FLY OR OX BOT FLY

Æstrus bovis, Clark; *Hypoderma bovis*, DeGeer.

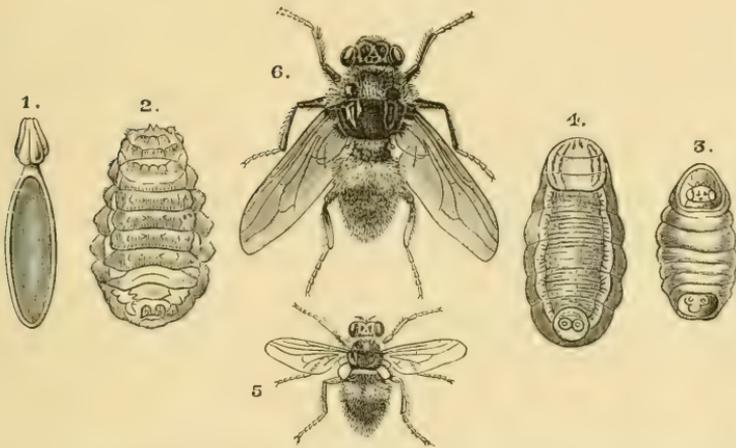


FIG. 1.—*Hypoderma bovis*. 1, egg; 2, maggot; 3 and 4, chrysalis-case; 5 and 6, fly; 3 and 5, nat. size, after Bracy Clark; the other figures after Brauer, and all magnified.

NEARLY two hundred years have elapsed since the first noticeably recorded observations were made on what we now know as the Warble Fly, scientifically the *Hypoderma bovis* of DeGeer. Those who wish to work up the early notes on this infestation, which, though often uncertain in identification, and dealing partially and incompletely with the subject, still lead on towards what we now have advanced to, will find a list of the chief writers, beginning with Vallisneri in the year 1710, in Friedrich Brauer's invaluable book on the *Æstridæ*.^{*} Passing onwards down the list,—by the names of Reaumur, Linnæus, Geoffroy, DeGeer, Fabricius, and other well-known writers,—we arrive (at the date of 1797) at Bracy Clark, the eminent Veterinary Surgeon, of whom Prof. Westwood, the late Life-President of our own Ento-

^{*} 'Monographie der *Æstriden*,' von Friedrich Brauer, pp. 124—126; Wien, 1863.

mological Society, wrote that to him "we are indebted for a history of many species of this family which leaves nothing to be desired"; and Prof. Riley (late Entomologist of the U. S. A. Department of Agriculture) remarked,—relatively to information given by him on Warble Fly,—“One of the best accounts appeared nearly one hundred years ago in the *Transactions of the Linnean Society of London*, 1797, vol. iii. p. 289, in a paper read by Mr. Bracy Clark entitled ‘Observations on the genus *Æstrus*,’ in which the habits and means against the Ox Bot were detailed practically as they are known to-day.”

This is not to be quite literally taken now, for in recent years information has been gained, and advance has been made in kinds of applications serviceable for dressings; but still, Bracy Clark’s observations—whether known, and acknowledged as his, or not—stand as our centre of serviceable knowledge for practical farm use.

Since his day, as well as before it, much has been given by such eminent writers as Latreille, Meigen, Westwood, and others enumerated in the list before mentioned, including many papers by Dr. Brauer. But these are not easily accessible, and in many cases are simply technically entomological, and as it was very desirable to place before those practically interested in the subject some amount of information in a form easy of access, regarding the history of Ox Warble attack, and means found practicable and serviceable for its prevention in this country, at the present time, by our own agriculturists and cattle owners, I undertook in 1881, whilst Consulting Entomologist of the Royal Agricultural Society, to endeavour to gain trustworthy information on these points. My applications were most courteously and widely responded to by leading cattle owners, farmers, and also by heads of hide and tanning firms, and cattle and butchers’ associations, and for special points of investigation I was greatly helped by co-operation of some of our leading veterinary surgeons. Specimens were forwarded, and arrangements made, enabling me to examine the infested hides in fresh state, and, when necessary, the newly flayed carcase,—in fact, nothing was left undone to forward the research. I invariably met with the most cordial co-operation, and the results of the year’s investigations were published yearly, each item of information being carefully acknowledged to its sender, and a copy of the report sent to each contributor, so as to give opportunity of correction of any error in statement.

So the work, our joint national work, has continued, and its published results have spread over a large part of the world. It has long been well known in various of our colonies, and in the United States of America; it has been translated for Continental use; and at home about 150,000 leaflets—some on Warble attack, some on Licked Beef, one of the results of Warble attack,—have been circulated,

besides translations of the Warble Fly leaflet into North and South Welsh dialects.

All this has been done by ourselves; no "Board" has helped us; we have had no grant for expenses, and now it appears desirable to bring forward in a condensed form,—amongst other reasons that those interested may be able to recognize and point to the results of their own labours,—a history of the results of our ten years' labours.

To begin with a description of the attack. *Warble attack is commonly known as consisting of swollen lumps—few or many—to be found from February to September, chiefly during the months of April and May, though sometimes badly later in the summer, on the back or loins of the attacked animals, each swelling or warble containing a maggot or "bot," which lies with its black-tipped tail (often taken for its head) at a small opening in the swelling, and the other end (which contains the orifice which serves for a mouth) in a sore on which it is feeding in the under tissues of the hide.*

The great injury, however, which is caused year after year by this attack is not only from the perforations of the maggots lessening the value of the hides, but the loss in flesh and milk and health in summer, when the animals are started by their terror of the fly to gallop as fast as they can go, and later on the suffering and drag on the system of supporting may be six, ten, twenty, or a hundred, sometimes even more than four hundred, of these strong maggots growing up to an inch in length and feeding on the sore, which they keep up from before the warble-swelling is observable in January or February until they are full-grown.

First observation of young Warble beneath the flesh side of the Hide.

On November 12th, 1884, a cutting from a yearling skin brought in that day was forwarded to me by Messrs. C. and H. Hatton, Barton Tannery, Hereford, with the note that they considered it showed first symptoms of warble-maggot. This piece of hide was about 12 in. by 4 in., and on the *flesh side* there were upwards of seven slight swellings about a quarter of an inch across, of a livid or bluish colour. each forming a raised centre to greatly-inflamed patches. Within the blue centre I found a small warble-maggot, just large enough to be distinguished by the naked eye when removed, but not plainly so whilst in the swelling, as the inside of this was of blood-red tissue, and *the small maggot was blood-red also*. Under the microscope it was easily distinguishable by its patches of minute prickles. From the red mass or maggot-cell I found that a fine channel, no wider than a hair, passed up through the hide to the surface. The course of this channel was easily traced by the blood which in handling the specimen was pressed from below along this gallery till it came out in a little drop on the

outside of the hide. These channels (of course examined microscopically) had no lining membrane as is the case further on; they were

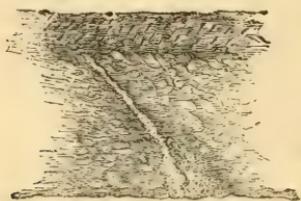


FIG. 2.—Section, magnified.

merely a passage (see fig. 2) apparently gnawed or torn by the mouth-forks of the young maggot, and they varied in direction, being sometimes slanting, or taking a straight course, or so completely curved at the upper part, that it was quite impossible that this channel could have been caused by the perforation of the

ovipositor (the egg-laying apparatus of the female fly), and in one instance in which the maggot-tunnel had only gone about half the way through the hide I found a small soft body lying at the bottom, which, though crushed in taking the section, appeared without doubt to be the maggot.

The egg is of the shape figured at p. 1, and is thus described by Prof. Riley, late Entomologist of the U. S. A. Department of Agriculture, from his own personal observations of warbled cattle in Illinois from 1860-1863, when interested directly in stock-raising, and having the charge of some three hundred head of cattle* :—" . . . The eggs of this Ox Bot are elliptic ovoid, slightly compressed, and have at the base a five-ribbed cap on a stout stalk with which to strongly attach them to the skin of the animal." Prof. Riley remarks that the grooved and slightly pedicelled enlargement of the end which is attached is admirably adapted for being strongly fastened to the skin, and to the base of the hairs, and all observations that have been recorded point to the fact that the young larva works its way directly from the egg under the skin. " . . . The structure of the ovipositor clearly excludes the possibility of puncture, for though horny, it has a blunt trifid tip, and is beset at the end with certain minute hairs."

The point of where the egg is deposited is very important relatively to effect of dressings, and there has been a great deal of what cannot but be considered vague speculation on the subject, as few of authority, excepting Prof. Riley, speak from observation. But we know that the ovipositor is not suited for purposes of boring; also I can speak personally to the borings through the hide not being such as could be formed by the passage of an ovipositor, and in the absence of any evidence from observation of the eggs being passed down through the hide, I believe that all the different points which we know from observation prove that the deposit takes place on the outside.

* See 'Insect Life.' Periodical Bulletin of U. S. A. Department of Agriculture, Vol. ii., No. 6, pp. 173, 174; Washington, U. S. A., 1889.

First observations of open Warble-swelling.

Careful watch was kept both on living cattle and newly-flayed hides in various localities throughout the winter of 1885-1886, in order to secure the date of the first appearance of the warble in its open condition, which took place (generally) from about the 14th to the 25th of February. The first advance on the condition of a mere hair-like streak through the hide was found in specimens cut from the hide of a young bull, and sent me by Mr. John Dalton, of Wigton, on Jan. 27th.



FIG. 3.

FIG. 4.

FIG. 3.—Maggots, club-shaped and worm-like, magnified. FIG. 4.—Mouth-forks of young maggot, much magnified.

Following this I had observations from various places in England and Ireland during February of the progressive enlargement of the warble-lumps,—as of lumps increasing in number and size; some “appearing like a gathering coming to a head.” On February 18th Messrs. Hatton, of Hereford, mentioned that they had received an ox-hide with many warbles in it, specimens of the maggots from which were forwarded; * and on the previous day they had informed me that notice had already been given that hides on Birmingham Market would be sorted for warbles, and those having more than three would be out-classed; and from various quarters, especially from Mr. Hy. Thompson, M.R.C.V.S., Aspatria, Cumberland, to whom I have been greatly indebted for assistance in our researches, I received specimens of infested hide, or of young warble-maggots.

In the earliest of these there was the first appearance of the warble as a *perforated swelling*, with the maggot of a clearly distinguishable size within. The channel through the hide was still very small, the opening on the outside being about as large as the prick of a common darning-needle, and below, though larger, scarcely the sixteenth of an inch across. The smallest of the maggots from these warbles were about a quarter of an inch long by a third of that measure in width, *not* as yet oval, but straightish, and somewhat worm-like in shape; when older they become rather enlarged towards the mouth-end, so as

* The cost of this hide was 29s., whereas the value of the same weight of hide free from warbles would have been 35s. 5d.

to be of a pear- or club-shape, white, and partially transparent, and marked across what may be called the back with sixteen short bands of very minute black or dark grey prickles, placed, for the most part, in alternate very narrow and broader stripes (see fig. 3, p. 5). The young maggot possesses (apparently as an instrument for tearing out food) a pair of crescent-shaped forks or diggers (see fig. 4, p. 5). These are of such excessive minuteness that they are only to be found with difficulty, and I have not as yet found them in any but very young maggots. The apparatus may be described as consisting of a pair of crescent-shaped forks, placed nearly side by side at the extremity of processes somewhat bent apart at the ends by which they are attached to the crescents, and attached by the other ends to the membranes or tissues forming the gullet or internal sac of the maggot. The material is chitinous or horny, and the possession by the embryo (still worm-like) maggot of this apparatus for cutting or tearing is of considerable interest in connection with the first minute track (which shows as being cut or torn) down through the hide to the embryo maggot lying below.

The power of pressure possessed by the maggots at this period of their life is enormous, from their capacity of inflating themselves with fluid until they are so hard that it is scarcely possible to compress them with the fingers, and likewise from their having (apparently) no power of discharging any of their contents. Thus they form living and growing plugs, quite capable of pressing back the tissues from around them, or from before the small hard tip; but *not* subject (so long as they continue inflated) to being themselves compressed. I had opportunities of watching this process of inflation both in the worm-shaped maggots and when they were slightly more advanced in growth to a club or lengthened pear-shape. On placing them in fluid suitable for absorption (as in glycerine and water, in which they would live for as long as eighty hours, or until the *spiracles* sank completely beneath the surface) they became hard and shiny, and with little trace of the segments which are so clearly marked when the maggots are fully developed; in fact, they were almost of a glassy smoothness, save for the short bands of minute prickles placed along a portion of the back.

This power of inflation of the maggot appears to be an important agent in forming what is presently the open passage or warble-hole down to the cell beneath. The various stages of maggot life consist of the passage of the worm-like larva to the under side of the hide, where, at this stage, in the small inflamed patches or swellings (see p. 3) it lies free, that is to say, not enclosed in a cell or thickened tissue, merely in a small bloody sore, in which by the colour of its contents it may be seen to be feeding on the bloody matter. This

changes, as above mentioned, to a more pear-shaped form, placed with the smallest end (containing the minute horny spiracles at its tip) uppermost, and thus with the compact hard-tipped apparatus above, and the growing body behind, is well calculated to force open and enlarge the passage down which it came.

The size and shape of the perforation through the hide altered progressively with the growth of the maggot. At first this passage was very little larger at the lower than at the upper opening; and, though the walls of the perforation had now become smooth and shiny, I could not distinguish the presence of any distinct lining membrane. With the enlargement of the passage its shape became more cone-like (corresponding with the altering form of its tenant); and, on March 5th, I found for the first time a distinct pellicle or skin-like membrane covering the walls of the perforation, or passage, and continuous with the lining of the maggot-cell below.

The great change, both in the appearance and the internal structure of the maggot, took place when it was grown to about a third of its full size, when it assumed its well-known shape. Previously to this, whilst the work of forming its passage was still in progress, its chief characteristics externally were the absence of everything that could obstruct its power of pressing onwards; and internally it was little more than a bag of fluid, with a large proportion of the space occupied by breathing-tubes,—a very important consideration relatively to available methods of destroying the creature. At the period, however, of its moult to its final stage a change takes place respectively in the nature, or in the amount, of development of nearly the whole of both the internal and external structure of the maggot. The hard tips necessary, or at least serviceable, for forcing a passage up the hide, are no longer needed, and they are exchanged for a broad form of spiracle (fig. 8, p. 8), and the internal organs become suited to provide material for the development of the fly, which will presently form in the dry husk of the maggot which serves as the chrysalis-case.

In methods of destruction of warble-maggot a large proportion turn on choking up their breathing-apparatus. This consists mainly of two large breathing-tubes, or *tracheæ*, which draw in air at the tip of the tail by two perforated bodies known as spiracles (see fig. 5).

From the earliest stages which I had opportunity of observing up to date of change mentioned in preceding paragraph the general form

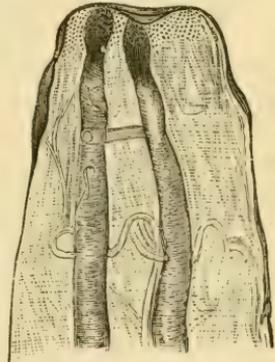


FIG. 5.—Breathing-tubes of maggot, magnified.

continued (see fig. 5, p. 7) to be that of a pair of short horny, somewhat bent cylindrical, or partially cylindrical, tubes, covered at the end (fig. 6) with round or oval discs, which appear to have a definite narrow border, and across the centre of the disc to be of a sieve-like or spotted appearance. Fig. 7 precisely represents the appearance when



FIG. 6.

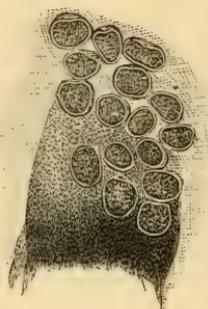


FIG. 7.

FIG. 6.—Spiracle-tube (one of the pair), much magnified. FIG. 7.—Discs at extremity of spiracle, as seen with quarter-inch object-glass.

much magnified. These discs may amount to as many as about six-and-twenty on each spiracle, and appear to me to be placed each at the extremity of short cylinders. Whether the spotted or sieve-like appearance is caused by minute hairs placed so to preserve the delicate tubes from the entrance of foreign bodies, I had not sufficiently high microscopic powers to ascertain. Up to the time when the moult takes place to the final form, these spiracles were in all the specimens I examined buried up to their disc-covered tips in the tail-end of the

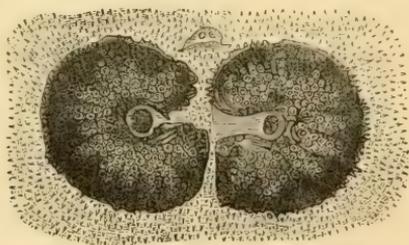


FIG. 8.—Spiracles fully developed, magnified.

maggot; then they are cast entirely with the moulted skin, and in the newly exposed surfaces beneath we find the first appearance of the well-known kidney-shaped spiracles (see fig. 8), but (in the specimens I examined) with the surface somewhat more radiated, and the colour of a paler chestnut than in their later condition.

The changes of condition appeared to be rapidly gone through, and it was when the maggot has gained about a quarter or third of

its growth that the spiracles were developed to their angularly kidney-shaped form, and the maggot assumed the compressed oval shape in which it is best known. It was still white, but opaque, and with the segments well-marked; and the early part of its work being done, and the warble-passage open, *it has no occasion now to bore its way, and ceases to be furnished with a form fitted for perforation.*

Other alterations of a very practical bearing also take place at this time, or follow on this most important of the moults. The skin of

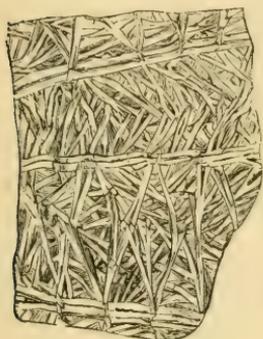


FIG. 9.

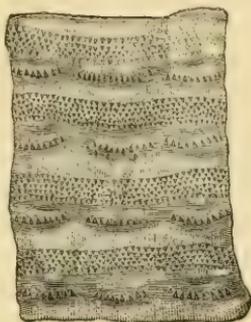


FIG. 10.

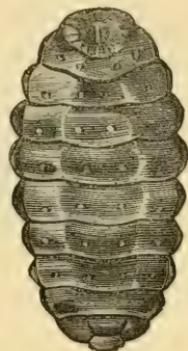


FIG. 11.

FIG. 9.—Muscles within skin of maggot, much magnified. FIG. 10.—Prickles of maggots, much magnified. FIG. 11.—Full-grown maggot, magnified.

the maggot becomes furnished within with a powerful coat of muscles, extending over it like basket-work, which give it a power of contraction and expansion. Externally in this stage the skin of the maggot is furnished with a much larger amount of prickles arranged in more numerous bands, than are noticeable in the previous stages. The prickles are now strong enough to cause an unpleasant sensation when the maggot crosses the hand, and to play an important part in its locomotive powers in its cell, and in the effect on the tissues caused thereby. The visceral contents are now thick, and obviously formed of the filthy matter which is caused by the perpetual irritation of the suction of the mouth-end of the maggot at the bottom of the sac. It is also now furnished with a small curved caudal aperture, placed nearly between the spiracles (see fig. 8, p. 8) from which some slight amount of discharge of contents can take place.

Fig. 11 shows the maggot about four times the natural size, in its fully developed state, with the tips of the pair of spiracles indicated in the centre of the tail-end. It is, as is well-known, when full-fed, and for much of its previous life, of a bluntly oval somewhat compressed shape, of various shades of colour, from whitish to deep grey or brownish, and marked with cross-bands, which, under the magnifier, are seen to be formed (as figured above) of minute prickles.

The above are the main differences connected with the moult to the final form of the maggot, and, following on these alterations in its structure, and especially on the power of keeping up a constant irritation by means of the muscular expansion and contraction of its prickly skin, we find the lining membrane of the cell increasing in thickness, until it becomes well defined as a tough wall round the perforation, continuous with the upper part of the cell. Fig. 12 shows a cell drawn in section, and slightly magnified after maceration in water. The lowest end of the maggot-chamber appears full of foul matter, caused by the irritation of the friction and suction of the

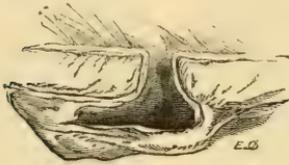


FIG. 12.



FIG. 13.

FIG. 12.—Warble-cell, slightly larger than life. FIG. 13.—Chrysalis of Ox Warble Fly, side view, and showing contained fly.

maggot; and, after the creature has crawled from its hole, a pressure on the empty warble is followed by a discharge of some amount of purulent matter.

When the warble-maggot is full-fed it presses itself gradually out of the opening at the top of the warble, which at first sight looks much too small for the exit, but the opening can be squeezed somewhat larger, the soft maggot is compressible, and is further helped in dragging itself out by the ringed shape and roughened skin, which prevent its slipping back again into its former hole. When it has fallen to the ground it creeps to some shelter, under a stone, a clod, or where may be convenient, and there the skin hardens into a chrysalis coat much like the grub, excepting in being dark brown or blackish in colour, and somewhat flattened on one side (see fig. 13). From these chrysalids the Warble Flies come out, in favourable weather, in about four weeks from the dropping of the maggot from the back of the cattle; in cold weather the time required for the change is longer.*

When the maggot has gained the condition mentioned above it undergoes no further great change until it turns to the chrysalis-state. The spiracles become less radiated and darker, the maggot also becomes darker as it increases in size; but the main points of its life now are to form, at the expense of the animal in which it lives, the material from which the fly will presently be developed.

* For details see 'Essay on Bots,' by Bracy Clark; 'Monographie der Œstriden,' by Friedrich Brauer and other writers.

In some observations taken by Mr. A. C. C. Martyn, Agricultural College, Aspatria, Cumberland, in 1885, of which he sent me notes, he found that the full-grown maggot squeezed itself out of the warble in the morning, or at some time between six o'clock in the evening and 8 a.m. the following day. This point he ascertained in the course of his experiments in rearing the chrysalis; in these he found the maggots leaving the warble stuck fast, or trapped, as the case might be, on bird-lime, or in the little bags fixed for them to drop into, in the morning, but never in the middle of the day.

In the case of eighteen specimens watched by Mr. Martyn, the chrysalis stage lasted about twenty-five days; but, to ascertain the effect of cold on rate of development, four chrysalids were put by themselves at a much lower temperature. These developed into flies (scientifically speaking, the pupæ developed into the imago-state) in an average of thirty-six days (that is, took ten days longer in development than the others), and the flies were not such fine specimens, not so large or well marked as the others.

The Ox Warble Fly, or Bot Fly (scientifically, the *Hypoderma bovis*), is a two-winged fly, upwards of half-an-inch in length, so banded and marked with differently-coloured hair as to be not unlike a Humble Bee. The face is yellowish; the body between the wings yellowish before and black behind; and the abdomen usually whitish at the base, black in the middle; and orange at the tip. The head is large; the wings brown; and the legs black or pitchy, with lighter feet. There are, however, some slight differences in colouring, and amongst those reared by Mr. Martyn, in the case of five out of the twenty-five, the portion of the abdomen beyond the transverse black band was grey instead of yellow or orange.



FIG. 14.—Ox Warble Fly.

The female fly has an ovipositor, or egg-laying tube, formed of telescope-like joints, and ending not in a point for piercing with, but a trifid extremity beset with small hairs (see p. 4). The egg-laying season is mostly in the warm part of the year, but as the time of presence of the maggots extends (as shown by trade reports of condition of hides) from February to September, so also must the existence of Warble Flies, to which these warble-maggots turn, extend to some degree over many months, and the date of egg-laying vary conformably.

Process of formation of the Warble.

The early part of this operation, including the minute maggot no thicker than a hair going down to the under part of the hide, and there lying feeding in the little bloody sore which it has caused, has been described, so also has its growth, until (tail uppermost) it lies in the

central hole of the swelling, with its feeding end, which cannot be called a head, in the foul matter of the cell, and the black spots, which are the ends of its breathing-pores, in the tip of the tail above. At this full-grown, or nearly full-grown, condition, removal of a maggot from the cell, and careful watching of it for a little while in the hand will show the powers with which it is furnished for its own safety, and great disservice to ourselves.

A maggot at this stage, besides the power given by its strong coat of muscles (see fig. 9) of contraction and expansion, which may be observed in protruding and withdrawing the mouth-end with the regularity of pulsation, has a power of movement so definite that it can drag itself along at the rate of three times its own length in two minutes, and with a definite method of progression. The mouth-end I observed to be somewhat raised, and the creature appeared to move with as settled a purpose as other grubs and caterpillars. Whilst still inside the warble, of course this power is unimportant, so far as "travelling" far is concerned; but it is very important as to giving it power to move up and down at pleasure in the warble-hole, causing constantly recurring discomfort. Externally at this stage the skin of the maggot is furnished with a much larger amount of prickles, arranged in more numerous bands than are noticeable in the previous stages. These prickles are now, I found, strong enough to cause an unpleasant sensation when the maggot crosses the hand, and, as well as the muscles, play an important part in its power of movement in its cell, and in its powers of irritation.

With regard to what the sensation might be caused by just one or a few (*Estrus* (that is, Bot or Warble) maggots working below the skin, taking the subject quite independently of the graver considerations involved, as the animals could not explain this, and I was aware that a somewhat similar attack occurs not unfrequently to the human subject in the more central parts of America, I wrote on the subject to Mr. Everard im Thurn, then resident in British Guiana, and well known for his scientific attainments, and also as the scaler of the (previously supposed inaccessible) mountain of Roraima, in those regions. Mr. im Thurn replied that he had himself suffered from the attack of warble-maggot a little below the knee, and he described the pain as not being constant, but from time to time quite sharp, as if the maggot was screwing itself round in its hole. This gives an idea of one kind of pain connected with attack of *Estrus* larva. Further, in communication with Mr. J. S. Macadam, Army Surgeon, British Guiana, he mentioned one case of a black soldier of the 1st West Indian Regiment, who presented himself, complaining of a sort of large boil with hard edges on the front of the throat, which had broken and would not heal up, and that the *itching round it at times* was intense.

Mr. Macadam gave me details of appearance of the maggots reminding "him of cattle-bots"; these he destroyed in boil or warble-like swellings, simply as we often do here, by excluding air, and drew up the description of the pain as being that of "an ordinary sore plus the intense itching."

Independently of effects on the constitution of inflammation, and ulceration (when cattle-attack is on a large scale), it certainly cannot be desirable, if their sensations are like those described, that even on a small scale they should be troubled by the pain of sores plus the intense itching, and also *plus* (what our warble-maggots have quite structural appliances to cause) pain, *at times* "quite sharp, as if the maggot was screwing itself round in its hole."

Formation of membrane or false-skin over surface of warble-hole or cell.

Coincidentally with the alteration in size, position, and condition of the maggot, and especially on the power of keeping up a constant irritation by means of the muscular contraction and expansion of its prickly skin, there are changes in the state of the surface of the cell in the lower part of the hide, and also of the surface of the passage up the warble swelling, which are of the greatest importance to tanners, and all connected with sale of hides. At a certain stage, instead of the surfaces being torn and raw, or presently, in part, of a glass-like smoothness, a distinct pellicle or skin-like membrane begins to form, covering the walls of the perforation or warble-hole, and also, and continuously with it, the greater part of the surface of the maggot-cell. The beginning of March is the earliest date at which I have myself found the lining pellicle observably forming, but the date must obviously vary with circumstances.

On the 3rd of March, 1884, Messrs. Hatton, of Hereford, favoured me with a piece of heifer hide, less than six inches square, containing twelve or more warbles, which had now advanced in growth, so as to show on the flesh side of the hide as well-defined lumps, ranging from three- to five-eighths of an inch across, and up to as much as three-eighths of an inch in height of the swelling.

All that I examined had openings on the upper side of the hide, and internally were now coated with a distinct formation of some kind of lining membrane, like thickened yellowish skin, continuous with the coat of the cell below.

At first the channel down through the hide, and the spot where the maggot lies below are merely sores or openings caused by the sharp mouth cutters of this then almost microscopic grub. *These injuries*

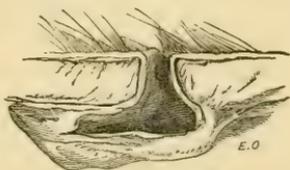


FIG. 15.—Section of warble-cell, after soaking in water.*

* Figure is repeated from p. 10 to save trouble in reference.

then heal up readily, and early in the year also they will heal fairly well; but where the maggot has been allowed to remain for several months, working itself about in the hole, which, by its growth, it keeps pressing larger, then the kind of false skin or film mentioned above forms over the surface of the cell (see fig.); and as this is not got rid of when the maggot is killed or removed, it is very apt to make a kind of plug in the hole, which prevents it drawing completely together for a long time, and thus causes much depreciation of the value of the hide, though not always noticeable by the buyer.

On July 9th, 1884, Mr. John Dalton wrote me from his tannery at Wigton:—"In two or three weeks after the escape of the worm the hole quite closes up, and the only trace remaining is the cicatrix where the wound has been. In some of the pieces of leather sent you might notice both holes and *marks*; the later were the healed wounds of the previous year. A warble-hole, like any ordinary injury to the skin, though healed, can always be traced, and no matter how long the animal may live, the scar remains." And Messrs. Thomas and Sons, of Llandillo, in the course of communication on warble injuries, mentioned that in one old cow-hide they found 500 scabs, these showing the traces of warble-attack in previous seasons.

I was also obliged, in 1889, by the following note on this subject from Mr. W. H. Hill, Vice-President of the Sheffield Butchers' Association:—"In one of my letters you may possibly remember my reference to the loss to the tanner on finding the *tanned hide* to be spoiled for the purpose intended, by the ravages of warbles, and to my explaining that traces of the warble-holes are left on the hide when tanned, even after the holes are closed up by suppuration. I have no doubt it will interest you to know that a few weeks ago a local tanner brought for my inspection a tanned hide of as good quality as can be found, and for which, being off a polled Scotch beast, and weighing 98 lbs. in the raw state, he had paid us an extra price over ordinary hides of a similar weight. When purchased in the raw state no distinct traces of warbles could be seen, but on being tanned the grain-side in the best part of the hide was speckled, ragged, and blistered, where formerly warbles had been. The tanner, who is reliable, stated the difference in value and loss on this one hide would be at least 25s., and probably 30s."

The following observations, of which the four first were sent me in 1885, give examples of the severity to which warble-attack runs.

Such specimens as were sent accompanying were in a shocking condition, and, if not the cause of the death of the animals, must have severely aggravated the effects of illness.

"I to-day received the skin of a young bullock, about one year and

a half old, which was very much warbled, and which showed signs of a considerable amount of inflammation. I have cut a piece out and forward it for your inspection. . . . You will notice that the membrane covering the warble is much thinner than at a later period. I cannot help thinking that the death of this animal has been brought about solely by warbles: the irritation caused by the presence of so large a number must have been very great, and it may be supposed the draw upon the system to supply such a large colony with food must have been more than could be borne." — JOHN DALTON, Wigton, March 28th, 1885.

[The thinness alluded to was very noticeable, the segments of the maggot being clearly discernible through the membrane. The piece of hide contained eight or nine warbles in a space of not more than two and a half inches square, and was in a state of inflammation. The maggots were upwards of a sixth of their full growth, and the warbles containing them in some cases so close together as not to be clearly distinguishable from each other.—ED.]

"Almost immediately after receipt of your letter to-day we had the skin of a yearling sent in; it was covered with warbles down the centre of the back. The man who brought it said they considered it died of 'blackleg.' We think the warbles killed it. This makes the fifth within the last four or five days, all supposed to die of 'blackleg, or quarter-evil,' but all equally affected by warbles. By this post we send you a box of the maggots, all of which the writer cut out within the space of this sheet of paper."—Messrs. C. and H. HATTON, Barton Tannery, Hereford.

"We received a hide to-day taken off a beast supposed to have died of 'blackleg.' Looking at it spread open, it was most distressing to think that a poor beast should be allowed to get in such a state. However, we have cut the centre out, and send it you by this post."—Messrs. C. and H. HATTON, Barton Tannery, Hereford.

[The piece of hide was 28 in. long by 8½ in. at the widest part, and contained upwards of seventy-two warbles.—ED.]

From Mr. W. Williams (tanner), of Haverfordwest, I heard (when writing regarding distribution of leaflets):—

"I should make a point of giving a copy to each farmer when paying him for his dead hides, of which great numbers come in every spring with their backs in a mass of jelly from warbles. I have sometimes pointed out cases where the warbles were sufficient to cause death, but the farmers will not believe it, and say it was inflammation of the kidneys."

In the course of our investigations, through the courtesy of Prof. Wortley Axe, of the Royal Veterinary College, Camden Town, who at my request examined for me the heart of a runt which was warbled

(not specially largely, but just along the course of the spine), it was found that blood-poisoning was certainly coincident with the sudden death of the animal; and I have many other notes showing the illness, even up to death, in bad cases of warbles.

The following observations, forwarded in 1888, are just a few examples of the communications sent me regarding serious injury to the condition of the infested animal, in some cases ending in death, occurring from warble-attack.

Early in May, Mr. Charles Magniac, of Colworth, near Bedford, wrote me:—

“Your lecture at the Farmer’s Club suggested to me that a young steer I saw lately on my farm was dying of warbles. I have examined him to-day, and have no doubt of it. His back is like a newly-metalled road.” On May 8th I received a note from the bailiff (from the Colworth Estate Office) that the animal was dead.

On June 9th Mr. G. E. Phillips, Treriffith, Moylgrove, near Cardigan, reported without doubt of the serious nature of the attack, and I give his *precise wording*, as I do not know that any would be more appropriate to the misery caused by the feeding of more than two hundred maggots on one wretched animal:—

“These infernal maggots are something abominable this season. I and my man actually squeezed 210 out of the back of a yearling beast, and had to leave many behind; the poor creature was nothing but a mass of corruption.”

Mr. M. Johnson, writing from Varmontly Hall, Whitfield, Langley-on-Tyne, mentioned:—

“I live where it is all grazing farms, and the good work has not begun yet. Several of the cattle which were grazed on our highest land did very badly through the winter, and I could only keep them up with very good feeding. These turned out to be totally covered with warbles. Some of the lumps when squeezed out contained nothing but a lot of sticky matter: they have got the turn now, but I firmly believe it was nothing but the warble-attack that was killing them.”

On May 28th Mr. Francis Drawfield, Alton Manor Farm, Wirksworth, Derbyshire, sent me the following account:—

“In the beginning of April I had a heifer that began to lose flesh (of course she was in calf), and all the good keep and care would not prevent the flesh from going.

“She went on till the beginning of this month, when she got down and could not get up, but still kept on eating as usual.

“I had her removed into a warm paddock; I set a trough in front of her with bran, linseed-cake, and malt, which she continued to eat; I mashed her malt and put gentian-root into the mash, and she drank

the liquid from the mash. We left her at night to all appearance as lively as usual, but the next morning we found her dead.

“When taking off the skin, I found from the shoulders to the hips bored one complete riddle with warble-maggots.

“In counting, I found no less than 310 holes; on taking it to the tan-yard, they pronounced it good for nothing.

“There is no doubt the warbles were the cause of death.

“It will be a great blessing for the poor cattle if something is found out to remove the pest.”

On June 16th the following note was sent me by Mr. John R. Golding, of Baunmore, Clare, Galway, Ireland, regarding serious amount of injury from warbles:—

“Owing to the prolonged excessive heat last summer, the warble-pest has done great injury to young cattle in this district, causing death in some instances by their numbers, from March last up to this.”

Another note on the same subject was sent me on May 15th, by Mr. Thomas Barrett Lennard, of Horsford Manor, Norwich, who wrote:—

“Many of my beasts have bumps, but one—which is so thin and wretched that he seems not long for this world—is one mass of bumps.”

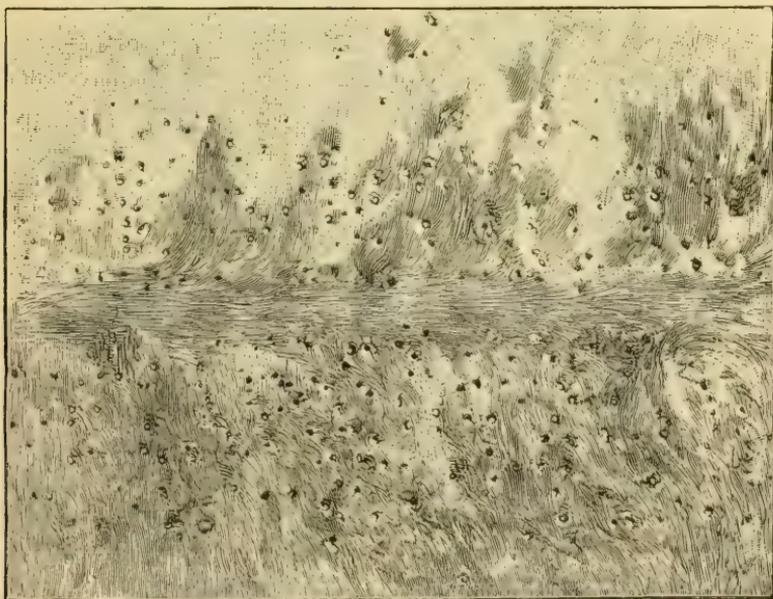


FIG. 14.—Piece of yearling skin with 402 warble-holes.

From specimens then sent to myself, I was able to speak personally to the serious extent to which the attack would run on. In one of the

hides, that of a two-year-old heifer, there were 300 warble-holes; and in another taken from an animal which died on consequent mortification of the back, there the warble-holes were more than 400 in number. The accompanying figure (see previous page), giving some idea of this damaged hide, though necessarily in miniature, is from a photograph presented to me by Messrs. R. Parsons and Son, tanners, East Street, Taunton, of a piece of a yearling skin, 24 by 14 inches, containing 402 warble-holes.

Loss on the hides is a very serious matter, and special estimates and calculations are given on this head by themselves further on; but in the above observations the condition of the hide has chiefly been alluded to in connection with the illness or death of the attacked animal, of which the infested hide showed the cause, sometimes little suspected until attention chanced almost accidentally to be directed to

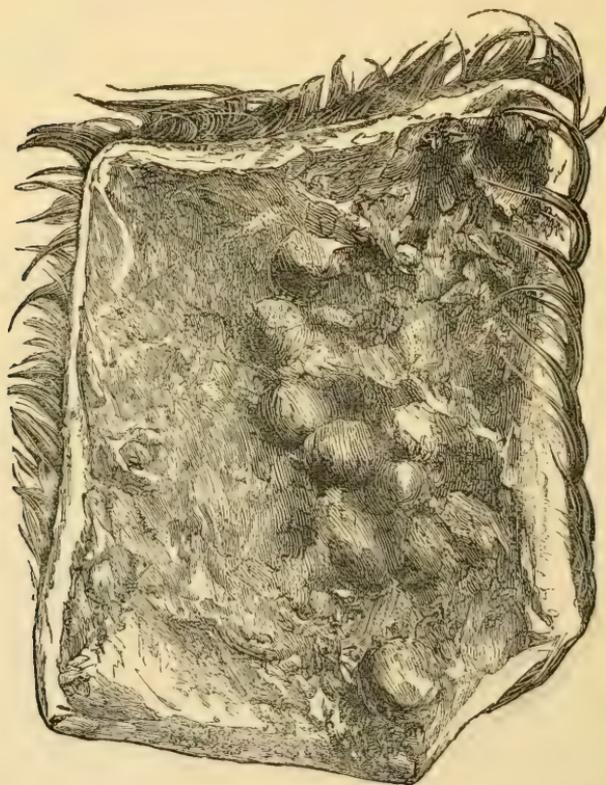


FIG. 15.—Piece of under side of warbled hide; warbles about half-size.
From a photo by Messrs. Byrne, Richmond, Surrey.

it, as in the observation of the late Mr. Magniac, of Colworth. But bad as this loss on hides is,—and to be counted by hundreds and even thousands of pounds per annum to individual firms,—this is only a

part of the loss caused by warble-attack: in the words of Mr. R. Stratton, of the Duffryn, Newport, Monmouthshire, to whom I have from the beginning of our work been greatly indebted for co-operation, "it is as pennies to sovereigns" compared to the loss on the animals.

Licked Beef.

Warble-attack, when severe to an extent often found to be the case, causes inflammation, and consequently very evident alteration in the state of the tissues immediately beneath the warbled part of the hide.

This condition, known as "licked beef" or "jelly," has long been only too well known to all connected with dressing cattle after slaughter, but the nature and precise cause of the condition was, as far as I am aware, *not* known. And *in the year 1889* we were enabled, through *post mortem* examinations, to obtain clear proof of connection between presence of inflammation seriously injurious to condition of the animal and presence of warble in the overlying part of the hide.*

In the investigation I was greatly indebted for assistance to Prof. John Penberthy, of the Royal Veterinary College, Camden Town, N.W.; to Mr. Henry Thompson, M.R.C.V.S., of Aspatria, Cumberland, who has long devoted much attention to warble-treatment; and also to Mr. John Child, Managing Secretary of the Leeds and District Hide, Skin, &c., Company.

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

"With reference to what you call 'licked beef,' I suppose you mean that portion of the back (sirloin) where the warbles are generally most numerous, and, when ready to leave their quarters, cause so much irritation that the cow licks them with her rough tongue, and assists in their removal, and is thus thought by many to damage the flesh underneath; hence the name, 'licked beef.' But I cannot see

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

this; the heavy, thick skin will protect the beef from being damaged with the cow's tongue; therefore, in my opinion, the term 'licked beef' is a misnomer.

"Now, what causes the damaged meat, or beef, is the chronic inflammation set up by the warbles in the skin, which extends to the connective tissues, thence to the flesh, producing the straw-coloured, jelly-like appearance of a new-slaughtered carcase of beef, which in twelve to twenty-four hours, when exposed to the air, turns a dirty greenish yellow colour; and this spoils the beef, having a frothy discharge oozing from the surface, with a soapy-like look; hence the name, 'licked beef.'"—H. T.

With regard to this altered material, which has to be scraped away, Mr. John Child, Manager of the Leeds and District Hide, Skin, and Fat Co., wrote me on the 3rd of July:—"In the worst part of the warble season I could get you bucketfuls of inflamed tissue (commonly called by the butchers, 'jelly'), cut and scraped from the carcase after the hide is taken off. The formation of this matter must be a great drain on the health, condition, and quality of the animal, and must be a great loss to somebody."

The height of the warble-season was then quite past, but on July 16th Mr. Child forwarded me a sample of this so-called "jelly," with the remark that it was "difficult to get at this time of year. When the grub leaves the hide, the inflamed tissue soon diminishes, and in a very few weeks disappears altogether; but during the most active part of the warble-season the condition of the carcase of the animal is such as to considerably reduce the value to the butcher."—J. C.

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

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

In reply to my enquiry as to how I should rightly describe the

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

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

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

On the 17th of May a very good specimen was sent me, by favour of Mr. Henry Thompson, from Workington, in Cumberland. This was a large piece, containing the back-bone, flesh, and hide, all cut right out of the centre of the animal after slaughtering. This was an excellent specimen for our purpose, because it was so moderately warbled that it showed how mischief may arise, even from an average or less than average amount of warble-presence.

Regarding this specimen, Prof. Penberthy (who kindly examined it for me) wrote me from the Royal Veterinary College on May 20th :—" The parcel arrived quite safely, and the contents in good preservation." . . . " In a superficies of 450 inches I found eighteen well-developed and eight very small warbles. There was, however, ample evidence of inflammatory products.

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

" This morning, in those parts in which the warbles were most

numerous, putrefactive change was much more advanced than in those in which there were no warbles."—J. P.

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

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

Amongst various more general observations in Mr. Pearson's letter, sent to me at his request by the Editor of the 'Meat Trade's Journal,' he added the following very just remarks as to loss caused to owners by the wearing pain and discomfort in which the animals are kept by presence of warbles:—

"They are a pest not only to the butcher as a matter of loss, but, from a humane point of view, to the poor beasts that suffer from them, . . . causing a great amount of pain that might be avoided if only the farmer would be at the trouble *to try at least* to rid them of the pest. Of course, while the animals are suffering physical pain the owners themselves are suffering in pocket, and more than they imagine; the loss results from the lowering of the condition of the cattle, and the dairy-farmer loses from the yield of milk, not only reduced in quality, but also in quantity, and it is an impossible thing for the general health of the cattle to be so good when suffering the pain caused by the warbles."

I have myself also had the opportunity of seeing the altered state and colour of parts of the surface of a carcase from which the hide, when removed, had been found to be so infested with warbles that I was asked to come and look at it. This was at Spring Grove, near Isleworth, and the butcher cut thin slices off the discoloured yellow

part to show me how much the condition was altered from that of the healthy portions.—ED.

The hide in this case, and in the others in which pieces were sent to show the condition when badly infested, was a truly loathsome sight. The figure at p. 18 shows just a small piece with the warble-cells as they appear on the lower surface when the hide has been removed, but in this case only half the full size. Those whose business connects them with observation of this state of things know well what a sight a much-infested, newly-flayed hide is. Those who do not may imagine the inner side scattered over along the region of the loins or upper part of the back with a quantity of loose baggy-looking lumps, which, if watched, will show the shape of the thick fleshy maggots, up to about an inch in length, wriggling about within, and in some cases breaking out through the thin tissues of the lower part of the hide. With this comes the flow of the filthy matter they have been feeding on, and the sight, accompanied by all the various discolorations from inflammation, ulceration, and other wretched circumstances, is, in the words of the heads of one of our tanning firms, "truly sickening."

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

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

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

The following note was given me at the beginning of April by Mr. John Risdon, of Golsoncott Farm, Washford, Taunton (auctioneer to the Devon Cattle Breeders' Society):—"I received your communication on my way to Taunton Market on Saturday; one butcher, well known to me, and a man of great experience, told me he killed a bullock a few days before so discoloured by licking the warble-grubs that he had to scrape off nearly the whole of the spine (fat) to render the carcase presentable for sale."

To these may be added the following detailed note turning partly

on presence of the condition known as "licked beef," with the accompanying "butcher's jelly"; and also noting the loss on hide, loss on meat, and loss from the warbled animal not answering properly to her extra good keep.

On April 10th, 1889, Mr. James Sparkes, of Wearhead, Darlington, forwarded me the following information regarding loss consequent on bad warble-presence in the case of a heifer he had lately sold:—

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

A few days later, in reply to my request for further details, Mr. J. Sparkes wrote me that the butcher had found the badly-warbled animal above mentioned:—"Down the spine was frothy, loose, and mattery, or suppose in a sort of jelly-state, and (as I said in my last) some of the beef to scrape before sending it out. The loss on hide, 1d. per lb.; suppose that would mean on hide, 5s.

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

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

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

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

Mr. W. C. Brown, Newcastle, writes:—"In reply to your note of to-day respecting 'licked beef,' my experience teaches me that the

quality is not at all deteriorated; it interferes very much with the outward appearance, and more if the beef hangs for a week or more; the colour becomes somewhat darker, but certainly it *has not a bitter taste*, for only on Sunday last we cooked a piece (of beef of that character) from an animal slaughtered ten days before, which was very much licked, and beef of better quality no one could eat."

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

It is perhaps worse than useless to venture a conjecture where those who thoroughly understand the subject differ amongst themselves in opinion, but it does occur whether the difference in bitterness of taste may not be according to the completeness with which the diseased tissues above the meat may have been removed.—ED.

With regard to age of cattle at which infestation has been found most prevalent, it will be seen by casting the eye along the columns of the *folding table* of particulars of sound and warbled hides sold at one of the Birmingham markets, that the three heaviest classes named, ranging from 75 lbs. to 95 lbs. and upwards, do not suffer as much as the three lighter classes, of which details are given on the same table.

The three lighter classes (that is, the classes weighing 65 to 74 lbs., 56 to 64 lbs., and 55 lbs. and under) are principally heifer hides, and are shown by the table to be the greatest sufferers. We also find that in these three lighter classes infestation was found continuing from about seven to sixteen weeks later in the season than with the three heavier classes, warble being still present in the lighter classes to some degree up to Sept. 19th. Dates from Feb. 14th to Sept. 19th, 1885.

The following notes give some individual observations on the subject of the warble-maggots being found in young things, down to the size of animal of which the back can be reached by a little lad of ten years old. These are perhaps no information to all versed in warble matters, but are inserted partly in reply to an enquiry, or erroneous view, recently sent me:—

"Cattle at the age of one or two years are most subject to attack."
—JOHN DALTON, Wigton, Cumberland.

"Young (yearling and two-year-old) beasts are most subject to attack [of warbles], and shorthorns more so than the thicker-skinned Welsh or Scotch breeds; the hide of a Welsh 'runt' is quite twice as thick as that of a shorthorn bullock."—E. A. FITCH, Brick House, Maldon, Essex.

"They are worst upon young cattle, if they strike, as they often

do, when they are stirks six or eight months old. The infliction takes greater effect upon a young growing animal than upon one that is older and fuller in condition."—W. H. LIDDELL, Leather Market, Bermondsey, London.

"I notice that nearly all kips (that is, hides off yearling cattle) that have died a *natural* death are covered with warbles. Are deaths of these almost calves to be attributed to the fact that the irritation they cause exhausts nature?"—H. C. HAINES, Newport, Mon.

On Feb. 24th (see my Warble Report for 1884), Mr. H. Thompson, M.R.C.V.S., Aspatria, Cumberland, reported that on that day some of the pupils at the College of Agriculture had found several enlargements on the backs of *young cattle* at the farm; and in the course of our work, carried on by the boys of the Aldersey Grammar School (referred to in detail further on), one little lad, only ten years old, not to be behind his fellows in the extent of his powers, as he could not reach up to the full-grown cattle, brought in his contribution of maggots, which he had squeezed out of the calves.

The almost world-wide distribution of this cattle-pest is important relatively to possibility, or rather certainty, of its importation from some countries, and also of its general transmission colonially. I have myself been consulted in the case of transmission to a Cheshire farm from the U.S.A.

The following note gives the wide distribution of the species on the first-rate authority of Dr. Friedrich Brauer.* This species is distributed from Scandinavia to the most southern parts of Europe, and is also to be found occurring in Asia, Africa, and North America." . . . "A beautiful variety was shown me by Prof. Löw, from Asia Minor. This differed from the ordinary species in all of what are usually yellow hairs, being in the variety of a pure white.†

The following notes of amount of injury to imported hides, for which I was indebted to the courtesy of the Colonial Company in favouring me with a reply to my enquiry, add a very solid practical confirmation to Dr. Brauer's entomological statement:—

On the 8th of August, 1884, Mr. B. Brown, Secretary, wrote me as follows:—"I enclose copy of reply I have just received from an experienced firm of hide and skin brokers to an enquiry we made of them as to the injury done to hides, &c., by the Warble Fly."

"Reply to the inquiry of the Colonial Company respecting the damage done to hides and skins by the Warble Fly:—

"Parcels of Ox- and Cow-hides and Goat and Sheep skins coming

* See 'Monographie der (Estriden,' von Fr. Brauer, Wien, 1863, p. 127.

† This to some degree resembles the variety of which a few specimens were found by Mr. C. C. Martyn amongst the Warble Flies which he reared from chrysalids captured by himself at Aspatria, Cumberland (see p. 11).

from all parts of the world, all contain a varying proportion of warbled hides and skins, the damage, as a rule, being greatest on those from the hottest climates, and generally affecting goat skins to the greatest extent.

“ ‘ Those hides and skins coming from Mogador and other northern parts of Africa suffer most in this respect, an average perhaps of about one-fourth of them being damaged to the extent of 60 or 70 per cent. Those from Kurrachee also suffer damage to almost the same extent, while those from Calcutta, Madras, and Bombay are depreciated perhaps to the extent of 50 per cent. on 10 per cent. of the skins.

“ ‘ From Cape Colonies the damage is comparatively slight, and still less in those hides and skins from Australia and South America.’ ”—Communicated by sec. of Colonial Co., Leadenhall Street, London.

The great injury, however, which is caused year after year by this attack is not only from the perforations of the maggots lessening the value of the hides, but the loss in flesh and milk and health in summer, when the animals are started by their terror of the fly to gallop as fast as they can go, and later on the suffering and drag on the system of supporting may be six, ten, or twenty, sometimes even a hundred, or two, three or four hundred, of these strong maggots growing up to an inch in length and feeding in the sore, which they keep up from January or February until they are full-grown.

What the losses from effect of warble-attack may amount to yearly is difficult to calculate with certainty. Mr. W. H. Liddell, of Bermondsey, put it at two million pounds sterling annually to Great Britain and Ireland; and on March 3rd, 1885, Mr. Richard Stratton, of The Duffryn, Newport, Mon., remarked:—“ You have made one trifling mistake, and that is in the amount of my estimate of the annual loss sustained by the fly, you make me put it at *a million*, but I do not think I have ever put it at less than a pound per head on every animal unsheltered from the ravages of the fly, which would probably be seven or eight millions for the United Kingdom, and this, I fully believe, is not above the mark.”

This looks a large estimate just on the face of the thing, but a great deal of the amount may be fairly approximated, calculated out by returns of loss per stone, or per carcase, on damaged animals, and losses on hide, of which some notes are given below.

To these have to be added, for one thing, losses on fattening beasts; in the words of Mr. R. Stratton, on August 8th, 1884:—“ Cattle are suffering very much at this time from the fly. Fancy a fat beast having to run perhaps ten miles a day in this heat! Many lose £1 worth of beef in a week from this cause.”—R. STRATTON, The Duffryn, Newport, Mon.

Also as mentioned below:—

. “In the hot summer days our cows are tormented by the fly, and we frequently see them galloping with tails up to get out of the way of their tormentor; this lessens the quantity of milk, and prevents feeding cattle growing.”—D. BYRD, Spurstow Hall, Tarporley.

All who are at all connected with management of cattle know so well about the mischief caused by these wild gallops that it is not necessary to give observations of these in detail, more particularly as they have to be mentioned further on in the notes from contributors regarding successful methods of prevention and remedy; but all stock keepers and dairy farmers know to their cost the mischief thus caused, not only in delaying fattening, but danger both in the gallop itself, and risk of accidents to incalf cows, and also loss in quantity and deterioration both in quality and condition of the milk.

Loss on milk.—The only precise calculation I know of on the subject is thus referred to by Prof. Riley, late Entomologist of the U. S. A. Department of Agriculture:—“‘The Effect of the Warbles in the Dairy’ is the title of an interesting article by T. D. Curtis, in which the loss in the quantity of the flow of milk as well as its deterioration in quality, resulting from the annoyance of the animals by the flies while the latter are depositing eggs, and later by the grubs, is conclusively shown, and he estimates the shrinkage at 10 per cent., and the loss in quality at the same rate, making a total of 20 per cent.”—See ‘Insect Life.’ Periodical Bulletin of U. S. A. Department of Agriculture. Vol. ii., No. 5, p. 158. Washington, U. S. A., 1889.

The following note, from personal observations by Mr. D. Byrd, gives *approximate estimates of loss of value on growth of feeding cattle from disturbance, and on weight of cheese and percentage of milk* calculably lessened by the same cause:—

“We all know to our cost how greatly these tormenting flies irritate and madden the cattle, causing them to gallop or run, as if for their lives, to get away from the buzz and presence of their tormentors. Feeding cattle cannot grow in flesh without quiet and rest, and milking cows must suffer to a greater extent than we are aware of. To use a common remark, they soon ‘bate’—give less milk. To drive a cow fast, or cause her to be excited, reduces the quantity and quality of the milk. Without perfect quiet and rest they cannot do their best for us.

“This leads me to the one important point. What is our loss in the cheese-tub caused by the Warble and Gad Fly? I have tried to estimate the loss during the four or five summer months, or even the eight months that a cow is supposed to be in profit. There are certain times of unrest when the cow will give about one-half of her usual flow of milk. These tormenting flies, and the continued presence of

the prickly-coated warble-maggot, must keep up a perpetual uneasiness, and retard the growth of our feeding cattle to our loss, it may be, of £2 per head. In the dairy cows the loss will be greater. The daily loss of milk may make a difference of 1 cwt. or $\frac{3}{4}$ cwt. of cheese per cow per annum. Half a hundredweight, or $12\frac{1}{2}$ per cent., of milk less in a dairy making 4 cwt. at 70s., comes to 35s.; but $12\frac{1}{2}$ per cent. is too low an estimate: it may in some cases be put at £3 per head, and in a dairy of 100 cows would show a loss of £300.*—D. BYRD, Spurstow Hall, Tarporley, Cheshire.

With regard to direct loss in value of the carcase of the animal by beef being what is called "licked."—In some serviceable observations with which I was favoured in 1889 by Mr. John Child, managing secretary of the Leeds and District Hide, &c., Company, as to details requisite for forming estimate of our British loss in the aggregate from warble-attack, he mentions:—"The greatest loss on the worst carcasses of beef I ever saw, taking a number together, would not be less than £1 per carcase, or 6d. per stone; of course there are some exceptional cases worse than these, but they are rare—in fact so rare that they should not come within your calculations.

"I think I am right in saying that the depreciation in the value of licked carcasses of beef are from 6d. per stone down to 1d. per stone, and as the highest figure named comes in fewest number, the average figure for reduction in value should not be taken at more than 2d. per stone. Take the average weight of cattle affected by 'lick' and 'Warble' at forty stone, we have thus a loss on the carcase of 6s. 8d."—J. C.

This estimate of our scale of loss or lessened value on this one item appears to run lower than that in America. The above estimate at 1d. to 6d. per stone equalling 3s. 4d. to 20s. per carcase at average weight given, runs a good deal lower than the Chicago estimate of 2 dollars to 5 dollars per carcase, that is, 8s. to 20s. of our money. Our highest estimate is considered to occur so rarely comparatively,

* The above note also formed part of a paper communicated by Mr. Byrd to the 'Chester Chronicle' of Feb. 7th, 1884. Mr. Byrd's mention of "the Warble and Gad Fly" is very important, as these two very different attacks are often confused. The Gad Fly, *Tabanus bovinus*, is much larger than the Warble Fly; it does not injure the animals by means of its grubs, as these feed in the ground, but it causes mischief by driving its sucking apparatus into the cattle very painfully and drawing away the blood, and also, like the Warble Fly, by terrifying them into the wild gallops we know so well. From some of the various subsequent observations given it appears that the applications noted as useful to keep off one sort of fly are equally useful to keep off the other; and this point of the cattle so dressed being able to feed in peace whilst the others were being hurried in all directions is well worth consideration,

that our average loss as calculated above is 6s. 8d., not quite up to the lowest sum noted from Chicago.*

“The amount of this loss can be better appreciated, perhaps, by reproducing in condensed form the approximate estimate of the loss on the hides of cattle received at the Union Stock-yards of Chicago during the grubby season, which includes the months from January to June. Using the reports by States above given as a basis, it is estimated that fifty per cent. of the cattle received are grubby. The average value of a hide is put at 3.90 dollars; and while, from the report referred to, one-third value is the usual deduction for grubby hides in this estimate, but 1 dollar is deducted, or less than one-third. The number of cattle received in 1889 for the six months indicated was 1,335,026, giving a loss on the fifty per cent. of grubby animals, 667,513 dollars. When to this is added the loss from depreciated value and lessened quantity of the beef, the amount for each infested animal is put at 5 dollars, indicating a total loss on these animals from the attack of the fly of 3,337,565 dollars.”—See ‘Insect Life.’ Periodical Bulletin of U. S. A. Department of Agriculture. Vol. ii., No. 5, pp. 156, 157. Washington, U. S. A. : Government Printing Office.

As it is of a good deal of interest to be able in some degree to compare the proportion of warble-presence in infested cattle, and also estimates of rate of money-loss thereby in countries which (as in the present case) suffer connectedly by reason of cattle-traffic from this cause, I give the preceding observation, with some amount of estimate as to amount of warble-presence, and injury from it, in the U. S. A.; reference to the original reports is subjoined in the foot-note.

The great points of our national loss from warble-infestation turn on loss of health and sometimes death of the beasts, loss of milk, injury to produce in the herd, and loss of flesh in the fattening beasts. All this falls on the cattle owner, but also there is enormous loss *running through all classes* concerned on the warbled hides.

* During the year 1889, very widely extended investigations regarding warble-attack were set on foot, under the superintendence of Mr. A. S. Alexander, Member of the Highland and Agricultural Society of Scotland, and whilst still in this country one of the contributors to my own Annual Reports, then Editor to the ‘Farmer’s Review’ of Chicago, U. S. A. Circulars were sent out by the proprietors of the paper over an enormous area of stock-producing country, and much information sent in, of which some was valuable, some not so, but when sifted and arranged, the reports are well worth attention.

These will be found at length in the ‘Farmer’s Review’ (Offices 134, Van Buren Street, Chicago, Illinois, U. S. A.), in Nos. for July 17th, 24th, 31st, and for August 7th and 14th, 1889; and an abstract of these reports was published in the U. S. A. Department of Agriculture Bulletin entitled ‘Insect Life’ for Nov. 1889.

None but those very intimately concerned could be expected to wade through the masses of reports sent in, which I have, however, still at hand, but the above short abstract is of considerable interest.

This strikes first, of course, where the Warbles are first observed: it may come, like the rest, on the cattle owner or farmer; or it may come on the butcher or tanner; or further on it comes on the many trades in which leather, discovered after purchase to be pierced, is useless for its purpose,—a loss to the manufacturer; or a loss, or even a danger, to the wearer or user.

LOSS ON WARBLED HIDES.

In the following pages I submit returns of information with which I was favoured in reply to my enquiries regarding amount of money-loss on hides from warble injury (during one year, or during the warble season) from several of our chief hide markets, companies or associations connected with business in hides, namely, from Aberdeen, Birmingham, Boston, Bristol, Glasgow, Leeds, Liverpool, Manchester, Newcastle-on-Tyne, Nottingham and Sheffield.

Most of these were placed in my hands in the year 1888; but particulars on the annexed table, with which I was favoured by the courtesy of Messrs. Fry and Company, Leather and Hide Factors, Moor Street, Birmingham, was placed in my hands in 1884.

Particulars of seven weeks' supply of six classes of hides, being the total of each class of sound and warbled sold at two markets in Birmingham, commencing May 3rd up to and including June 14th, 1884, and showing the actual loss of each class of warbled hide:—

| Six Classes of Hides. | Hides. | | Sold at | Per hide less than the sound. | Loss on each Class. | | |
|-------------------------|------------------|--------------------|-----------------------------|----------------------------------|------------------------|----|----|
| | No. of sound. | No. of warbled. | | | £ | s. | d. |
| 95 lbs. and upwards | 286 | 67 | $\frac{3}{4}$ d. per lb. or | 6s. 3d. per hide | 20 | 18 | 0 |
| 85 lbs. to 94 lbs | 446 | 222 | $\frac{7}{8}$ d. ,, ,, | 6s. 7d. ,, | 73 | 1 | 6 |
| 75 ,, 84 ,, | 754 | 373 | 1d. ,, ,, | 6s. 8d. ,, | 124 | 6 | 8 |
| 65 ,, 74 ,, | 881 | 579 | 1d. ,, ,, | 5s. 10d. ,, | 168 | 17 | 6 |
| 56 ,, 64 ,, | 629 | 441 | 1d. ,, ,, | 5s. 0d. ,, | 110 | 5 | 0 |
| 55 lbs. and under ... | 283 | 224 | 1d. ,, ,, | 4s. 3d. ,, | 47 | 12 | 0 |
| Totals..... | 3279 | 1906 | | Total..... | 545 | 0 | 8 |

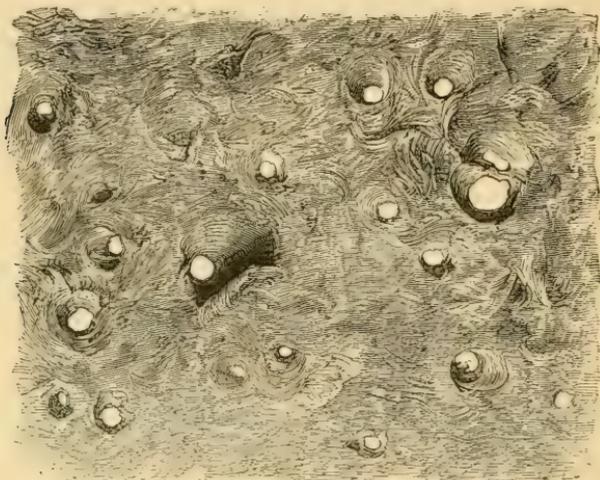
It will be observed that of the total number of hides (*viz.*, 5185) over one-third were warbled; and looking merely at one line of the figures, it shows that out of 1460 hides, ranging from 65 lbs. to 74 lbs. weight, 579 were lessened in value at the rate of 1d. per pound, or 5s. 10d. per hide, giving a total loss on these of £168 17s. 6d.

The above table of particulars does not include the three classes known as "heavy" and "light" cows' and bulls' hides, which also were warbled, but the numbers of which were not taken, on account of Messrs. Fry not being as much interested in these as in the other classes.

The following notes give amounts or approximate estimates of number of hides passing through various markets (specified) in the course of one year; also amounts or approximate estimates of the proportion warbled and loss thereon.

The first I was favoured with was from Newcastle-on-Tyne:—

“Last year (ending May, 1888) 102,877 hides passed through our markets, and of these we estimate that 60,000 were more or less



Portion of inside of tanned warbled hide.

warbled. Taking an average of five shillings each, which is rather under than over the mark, this gives a loss of £15,000 on our Newcastle hides from this cause for the year.”—J. MCGILLIVRAY, Secretary, Newcastle-on-Tyne Hide Inspection Society.

“Warbles begin to show in March and continue until October. Out of 35,000 hides passing through this market within this period, I should say that one-fourth, or say 8500, would be more or less warbled, and I should estimate the money loss at from £1500 to £2000.”—W. B. WELBOURN, Secretary, Nottingham Hide, Skin and Fat Market Co., Limited.

“Number of hides passing through our market in one year, about 30,000. Number of these that are warbled, fully one-third, or 10,000. Loss on these warbled hides, at least three shillings per hide, or a total loss of £1500 per annum. We believe the above to be fairly near, and rather under than over the mark.”—JOHN CHILD, Managing Secretary, Leeds and District Hide, Skin and Tallow Co., Limited.

“We should say that during the months of March to August inclusive there will be fully 60 per cent. of the hides more or less

affected, with an estimated loss of 2s. 6d. per hide average." -- JAMES WATSON & SONS, Hide Market, Whitehall Road, Leeds.

"The delay in forwarding this letter has been due to my ascertaining from our local tanners the effect of warbles on our supply of hides.

"I have no means of ascertaining definitely, and can only approximate the following results:--

"The hides suffer most severely from March to the end of August in each year; they are slightly damaged during the months of February, September, and October; whilst during the other three months of the year they show slight traces, after tanning, by the marks left after the warble-holes have closed up.

"Taking our supply of 50,000 hides (excluding odd numbers) sold during 1888, the amount of damage on the following basis would run thus:--

| | £ | s. | d. |
|--|------|----|----|
| 2s. 6d. per hide on 9000 hides, being one-third received from March 1st to August 31st ... | 1125 | 0 | 0 |
| 1s. 6d. per hide on 2500 hides, being one-fourth received during February, September, and October | 187 | 10 | 0 |
| 9d. per hide on 3000 hides, being one-fourth received during November, December, and January | 112 | 10 | 0 |
| Total | 1425 | 0 | 0 |

"Adopting another basis of calculation, taking the average to be 25 per cent. from March 1st to October 31st, and 12½ per cent. for the remaining portion of the year, and taking the damage at an average of 2s. 6d. per hide, the result would be £1250.

"I am inclined to think that both these estimates considerably under-rate the mischief done, and would especially point out that these figures refer only to the deterioration to the sale of the hides in a green state, and do not take into account the loss to the tanner on the finished article being depreciated in value, or the cost of labour and materials expended in producing leather which when finished is found to be unfit for the purpose intended.

"Another very important matter is the deterioration of the animal whilst living," &c. — W. H. HILL, manager to the Sheffield Butchers' Hide and Skin Co., Limited.

"I should say" the warble "makes from a farthing to sometimes a penny per pound difference to the butcher (about four or five shillings each hide difference)." — From a communication on the general bearing

of the subject, by Mr. JOSEPH WING, Hide, Skin, and Fat Broker, 16, Pen Street, Boston.

“*Re* warbles, we give you particulars as far as possible. The number of hides sold in the Hide Market in Liverpool and the American Lairage in Birkenhead is about 130,000 per year; this is exclusive of the hides under 30 lbs., which we call kips.

“We reckon the warbled hides to be—in the month of February, 20 per cent.; in March, 45 per cent.; in April, 30 per cent.; and in May, 20 per cent.

“The average weight of the above 130,000 we calculate at 65 lbs. each, and the loss in price at three farthings per pound.”*—Messrs. WHINYATES, WEBSTER, McNAUGHT & Co., Hide, Skin, and Fat Brokers, The Market, Gill Street, Liverpool.

“I regret I am unable to give you any *reliable* information respecting warbled hides, as in this neighbourhood we have never kept a separate class and account of them.

“Here we have thrown them into the same class as cut hides and damaged hides, and previous to some years ago we passed them as sound hides unless they were badly warbled.

“The Bristol slaughter of beasts would be about 700 per week, and during the summer and autumn months fully one-third of this number would be warbled. Some of the heavier hides would lose in consequence ten shillings per hide, and even more; but taking the heavy hides and light hides together, their average loss would be not less than five shillings per hide.”†—WILLIAM WILLIS, Bristol and Western Counties Butchers’ Hide and Skin Co., Limited, 88, Thomas Street, Bristol.

“In our market we have a system of inspection for all market hides, being hides of cattle slaughtered in Glasgow and neighbourhood for food purposes only. Under this system the hides are classified,—first and second classes, the latter being faulty flayed, and warbled hides.

“Referring to enclosed sheet you may note that in 1888 the total number of such hides have been 104,551.

* “We handle large numbers of horse-hides, and we never saw a warbled horse-hide.”

† “Taking the above estimate of 700 hides per week, would give 36,400 in the year, and 12,133 for four months (say) May to August inclusive. One-third of this amount (that is, 4044 hides), estimated to be warbled at a loss of five shillings per hide, would show a loss of £1011.”

Total Market Hides.

| 1888. | Firsts. | Seconds. | Totals. |
|------------------|---------|----------|---------|
| January | 5820 | 3361 | 9181 |
| February | 5476 | 5892 | 11368 |
| March | 3541 | 4559 | 8100 |
| April | 3582 | 3922 | 7504 |
| May | 3229 | 5618 | 8847 |
| June | 3144 | 3770 | 6914 |
| July | 3283 | 3231 | 6514 |
| August | 5020 | 3728 | 8748 |
| September | 4857 | 3084 | 7941 |
| October | 7228 | 3451 | 10679 |
| November | 6747 | 2647 | 9394 |
| December | 6811 | 2550 | 9361 |
| Total | 58738 | 45813 | 104551 |

“Taking the warble months as February to May inclusive, we find the proportion of second class to be 56 per cent., while from June to December the proportion is only about 36 per cent., being, on a fair calculation, an increase of 20 per cent. on account of warbles.

“If we then take the number slaughtered in February to May as about 36,000, we find 20 per cent. on that number yield 7200 warbled hides: damaged by warbles to the extent of (say) one penny per pound, at an average of 60 lbs. per hide, shows £1800 as the loss thus incurred.

“Further, we may legitimately add that, as the cost of manufacture is the same as for sound hides, the loss to the community or national wealth will show double the amount, or in round numbers a loss of £4000 annually in the district.

“No account is here made of Irish and country hides, of which we pass about 50,000 annually, and among which the damage is probably in a higher ratio than the others.”—Messrs. ROBERT RAMSEY & Co., Auction Brokers, Hides, &c., Greendyke Street, Glasgow, N.B.

The following table, with which I am favoured by Messrs. W. Murray & Son, of Aberdeen, gives the number of sound hides, and number of warbled hides, and estimated loss per week thereon from February 3rd to June 29th inclusive, and includes all the hides in Aberdeen, *viz.*, those of Messrs. Murray, and those sold by the Co-operative Company.

*Estimated Loss by Warble on Hides passing through Aberdeen Market
from February to June, 1888, inclusive.*

| Week ending | Number of Sound Hides. | Number of Warbled Hides. | Estimated Loss per Week. | | |
|-----------------------|---------------------------|-----------------------------|-----------------------------|----|-----|
| | | | £ | s. | d. |
| February 3 ... | 2344 | 418 | 80 | 19 | 9 |
| „ 10 ... | 2300 | 443 | 85 | 16 | 7½ |
| „ 17 ... | 2454 | 473 | 91 | 12 | 10½ |
| „ 24 ... | 2374 | 501 | 97 | 1 | 4 |
| March 2 ... | 2641 | 569 | 110 | 4 | 11 |
| „ 9 ... | 2124 | 611 | 118 | 7 | 7½ |
| „ 16 ... | 2249 | 602 | 116 | 12 | 9 |
| „ 23 ... | 2137 | 719 | 139 | 6 | 1½ |
| „ 30 ... | 2095 | 718 | 139 | 2 | 3 |
| April 6 ... | 2181 | 750 | 145 | 6 | 3 |
| „ 13 ... | 2207 | 755 | 146 | 5 | 7½ |
| „ 20 ... | 1699 | 705 | 136 | 11 | 10½ |
| „ 27 ... | 2021 | 640 | 124 | 0 | 0 |
| May 4 ... | 2308 | 755 | 146 | 5 | 7½ |
| „ 11 ... | 2257 | 754 | 146 | 1 | 9 |
| „ 18 ... | 2076 | 875 | 169 | 10 | 7½ |
| „ 25 ... | 1660 | 664 | 128 | 13 | 0 |
| June 1 ... | 2091 | 916 | 177 | 9 | 6 |
| „ 8 ... | 1981 | 747 | 144 | 14 | 7½ |
| „ 15 ... | 1943 | 771 | 149 | 7 | 7½ |
| „ 22 ... | 1685 | 751 | 145 | 10 | 1½ |
| „ 29 ... | 1446 | 693 | 134 | 5 | 4½ |
| Total for 5 months... | 46273 | 14830 | 2873 | 6 | 3 |

“Being about 25 per cent. of total number of hides affected by warble.

“Average depreciation calculated at ¾d. per pound. Weight of hides principally affected, 50 to 70 pounds.”—Messrs. WILLIAM MURRAY & SON, George Street, Aberdeen, N.B.

To the above returns I prefix (p. 31) and append the tables, with which I was favoured respectively in 1884 and 1885 through the courtesy of Messrs. Fry & Co., Leather and Hide Factors, of Moor Street, Birmingham, which show how the amount of loss may be calculated to a nicety at markets where warbled hides are “outclassed.”

The preceding table, it will be seen, does not include the three classes known as “heavy” and “light” cows’ hides, and bulls’ hides which also were warbled. In this table the results of calculation of loss on the six classes of hides only are given; in the folding table the cows’ hides are included, and the particulars are given week by week in detail from February 14th to September 19th.

This accompanying folding table, with which I was favoured by

Particulars of Sound and Warbled Hid viz.,

| | 95 lbs. and upwards. | | | Price. | 85 to 94 lbs. | 75 to 84 lbs. & vice. | | | Price. | Total Sound. | Warbled. | Price. | | | |
|-----------|----------------------|----------|--------|--------|---------------|-----------------------|----------|--------|--------|--------------|----------|--------|------|-----|--|
| | Total Sound. | Warbled. | Price. | | | Total Sound. | Warbled. | Price. | | | | | | | |
| Feb. 14 | O 11 | 5 1/4 | 44 | 1 | 4 1/2 | 29 | 4 5/8 | 31 | 4 1/4 | 63 | 0 | | | | |
| | X 33 | 5 1/4 | | | 23 | 5 1/8 | 23 | 25 | 4 1/4 | | | | | | |
| | O 15 | 5 1/4 | | | 9 | 4 1/4 | 52 | 19 | 4 3/8 | | | | | | |
| " 21 | X 15 | 5 1/2 | 30 | 1 | 4 1/2 | 17 | 5 1/4 | 24 | 4 3/8 | 47 | 3 | 3 5/8 | | | |
| | O 20 | 5 1/2 | | | 22 | 4 1/4 | 26 | 29 | 4 3/8 | | | | | | |
| " 28 | X 18 | 5 3/8 | 38 | 2 | 4 3/4 | 10 | 5 1/2 | 19 | 4 3/4 | 52 | 3 | 3 3/4 | | | |
| | O 23 | 5 1/4 | | | 16 | 4 1/2 | 32 | 22 | 4 1/4 | | | | | | |
| March 7 | X 9 | 5 5/8 | 32 | 4 | 4 7/8 | 11 | 5 1/8 | 19 | 4 3/8 | 55 | 7 | 3 3/4 | | | |
| | O 16 | 5 1/4 | | | 15 | 4 3/8 | 27 | 25 | 4 3/8 | | | | | | |
| " 14 | X 14 | 5 1/2 | 30 | 6 | 4 7/8 | 22 | 5 1/4 | 22 | 4 5/8 | 54 | 5 | 3 3/4 | | | |
| | O 9 | 5 1/4 | | | 21 | 4 3/4 | 37 | 22 | 4 5/8 | | | | | | |
| " 21 | X 12 | 5 5/8 | 21 | 3 | 4 7/8 | 7 | 5 3/4 | 15 | 4 5/8 | 44 | 6 | 3 3/4 | | | |
| | O 12 | 5 5/8 | | | 6 | 4 3/4 | 28 | 14 | 4 5/8 | | | | | | |
| " 28 | X 18 | 5 5/8 | 30 | 8 | 4 7/8 | 17 | 5 1/4 | 14 | 4 5/8 | 49 | 9 | 3 3/4 | | | |
| | O 14 | 5 5/8 | | | 20 | 5 1/4 | 23 | 16 | 4 5/8 | | | | | | |
| April 4 | X 10 | 5 5/8 | 24 | 6 | 4 7/8 | 7 | 5 1/4 | 26 | 4 5/8 | 33 | 9 | 3 3/4 | | | |
| | O 10 | 5 5/8 | | | 17 | 4 5/8 | 27 | 16 | 4 5/8 | | | | | | |
| " 11 | X 19 | 5 5/8 | 23 | 9 | 4 3/4 | 12 | 5 1/4 | 41 | 4 1/2 | 31 | 5 | 3 3/4 | | | |
| | O 16 | 5 5/8 | | | 18 | 5 3/8 | 29 | 17 | 4 1/2 | | | | | | |
| " 18 | X 8 | 5 5/8 | 24 | 11 | 4 7/8 | 12 | 5 3/8 | 33 | 4 1/2 | 34 | 10 | 3 3/8 | | | |
| | O 12 | 5 5/8 | | | 16 | 5 3/8 | 30 | 13 | 4 5/8 | | | | | | |
| " 25 | X 11 | 5 5/8 | 23 | 1 | 5 | 13 | 5 1/4 | 6 | 4 3/4 | 34 | 12 | 3 3/4 | | | |
| | O 9 | 5 5/8 | | | 27 | 5 1/4 | 29 | 41 | 4 3/4 | | | | | | |
| May 2 | X 6 | 5 5/8 | 15 | 2 | 5 1/4 | 10 | 5 5/8 | 17 | 4 7/8 | 39 | 5 | 3 3/4 | | | |
| | O 15 | 5 5/8 | | | 28 | 5 1/4 | 37 | 42 | 4 7/8 | | | | | | |
| " 9 | X 6 | 5 5/8 | 21 | 4 | 5 1/8 | 6 | 5 5/8 | 14 | 4 3/4 | 44 | 5 | 3 3/4 | | | |
| | O 5 | 5 5/8 | | | 13 | 5 1/4 | 34 | 39 | 4 3/4 | | | | | | |
| " 16 | X 10 | 5 5/8 | 15 | 5 | 5 | 7 | 5 5/8 | 12 | 4 3/4 | 40 | 9 | 3 3/4 | | | |
| | O 9 | 5 5/8 | | | 23 | 4 1/4 | 20 | 36 | 4 3/4 | | | | | | |
| " 23 | X 5 | 5 5/8 | 14 | 3 | 4 3/4 | 17 | 5 1/4 | 13 | 4 3/8 | 31 | 3 | 3 3/8 | | | |
| | O 15 | 5 1/4 | | | 15 | 4 3/4 | 40 | 28 | 4 3/8 | | | | | | |
| " 30 | X 4 | 5 5/8 | 19 | 2 | 4 3/4 | 4 | 5 | 13 | 4 1/2 | 28 | 5 | 3 3/8 | | | |
| | O 6 | 5 1/4 | | | 8 | 4 3/8 | 19 | 31 | 4 1/2 | | | | | | |
| June 6 | X 6 | 5 1/4 | 12 | 0 | 8 | 8 | 5 1/8 | 15 | 4 3/8 | 29 | 6 | 3 1/2 | | | |
| | O 3 | 5 1/4 | | | 13 | 4 1/4 | 14 | 33 | 4 3/8 | | | | | | |
| " 13 | X 2 | 5 1/4 | 5 | 0 | 7 | 7 | 4 1/4 | 16 | 4 3/8 | 40 | 7 | 3 1/2 | | | |
| | O 2 | 5 1/4 | | | 8 | 6 | 5 1/4 | 30 | 4 3/8 | | | | | | |
| " 20 | X 2 | 5 5/8 | 4 | 0 | 6 | 8 | 5 1/4 | 19 | 4 3/8 | 31 | 5 | 3 1/2 | | | |
| | O 2 | 5 5/8 | | | 8 | 7 | 4 3/4 | 23 | 4 3/8 | | | | | | |
| " 27 | X 1 | 5 5/8 | 3 | 0 | 7 | 11 | 5 1/4 | 16 | 4 1/4 | 33 | 9 | 3 1/2 | | | |
| | O 8 | 5 5/8 | | | 11 | 5 | 5 | 18 | 4 1/4 | | | | | | |
| July 4 | X 4 | 5 5/8 | 12 | 0 | 8 | 15 | 5 5/8 | 15 | 4 3/8 | 47 | 3 | 3 1/2 | | | |
| | O 6 | 5 5/8 | | | 8 | 12 | 5 1/4 | 25 | 4 3/8 | | | | | | |
| " 11 | X 10 | 5 5/8 | 16 | 0 | 9 | 12 | 5 5/8 | 13 | 4 3/8 | 44 | 8 | 3 1/2 | | | |
| | O 6 | 5 5/8 | | | 9 | 12 | 5 1/4 | 25 | 4 1/4 | | | | | | |
| " 18 | X 5 | 5 5/8 | 11 | 0 | 8 | 12 | 5 1/4 | 20 | 4 1/4 | 44 | 4 | 3 1/2 | | | |
| | O 5 | 5 5/8 | | | 8 | 12 | 5 1/4 | 20 | 4 1/4 | | | | | | |
| " 25 | X 6 | 5 5/8 | 11 | 0 | 9 | 12 | 5 5/8 | 20 | 4 1/4 | 44 | 5 | 3 1/2 | | | |
| | O 1 | 5 5/8 | | | 12 | 9 | 5 5/8 | 23 | 4 1/4 | | | | | | |
| Aug. 1 | X 15 | 5 1/4 | 16 | 0 | 16 | 16 | 5 5/8 | 18 | 4 3/8 | 45 | 3 | 3 1/2 | | | |
| | O 2 | 5 1/4 | | | 11 | 11 | 5 5/8 | 44 | 4 3/8 | | | | | | |
| " 8 | X 7 | 5 5/8 | 9 | 0 | 21 | 21 | 5 1/4 | 17 | 4 1/4 | 29 | 1 | 3 1/2 | | | |
| | O 2 | 5 1/4 | | | 12 | 12 | 5 | 29 | 3 3/4 | | | | | | |
| " 15 | X 14 | 5 5/8 | 16 | 0 | 22 | 22 | 5 1/4 | 19 | 4 3/4 | 44 | 2 | 3 1/2 | | | |
| | O 4 | 5 5/8 | | | 17 | 17 | 4 3/4 | 27 | 3 3/4 | | | | | | |
| " 22 | X 13 | 5 1/4 | 17 | 0 | 13 | 13 | 5 | 18 | 4 3/8 | 48 | 2 | 3 1/2 | | | |
| | O 6 | 5 1/4 | | | 17 | 17 | 4 3/4 | 38 | 4 3/8 | | | | | | |
| " 29 | X 15 | 5 5/8 | 21 | 0 | 14 | 14 | 5 1/4 | 21 | 4 1/4 | 56 | 0 | | | | |
| | O 7 | 5 5/8 | | | 21 | 21 | 4 7/8 | 37 | 3 3/4 | | | | | | |
| Sept. 5 | X 13 | 5 5/8 | 20 | 0 | 23 | 23 | 5 1/4 | 19 | 4 1/4 | 64 | 0 | | | | |
| | O 3 | 5 5/8 | | | 17 | 17 | 4 3/4 | 35 | 4 3/8 | | | | | | |
| " 12 | X 11 | 5 5/8 | 14 | 0 | 15 | 15 | 5 1/4 | 23 | 4 3/8 | 46 | 0 | | | | |
| | O 9 | 5 5/8 | | | 22 | 22 | 4 1/2 | 32 | 4 3/8 | | | | | | |
| " 19 | X 16 | 5 5/8 | 25 | 0 | 21 | 21 | 5 | 32 | 4 3/8 | 60 | 0 | | | | |
| 32 weeks. | | | 621 | 68 | | | | 911 | 138 | | | | 1382 | 151 | |

O for ordinaries.

X

Particulars of Sound and Warbled Hides, sold at one of the three Birmingham markets, from beginning of the warbled season, viz.,
February 14th; to the end,—September 19th,—1885.

| | 95 lbs. and upwards. | | | 85 to 94 lbs. | | | 75 to 84 lbs. | | | 65 to 74 lbs. | | | 55 to 64 lbs. | | | 45 lbs. and under. | | | Heavy Cows. | | | Light Cows. | | | | |
|-----------|----------------------|----------|----------|---------------|----------|--------|---------------|----------|--------|---------------|----------|--------|---------------|----------|--------|--------------------|----------|--------|--------------|----------|--------|--------------|----------|--------|------|-----|
| | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | Total Sound. | Warbled. | Price. | | |
| Feb. 14 | O 11 5 | X 33 44 | 1 4 1/2 | 29 23 9 | X 52 1 | 4 1/2 | 31 25 19 | X 56 3 | 4 1/2 | 44 26 46 | X 70 3 | 4 1/2 | 38 11 37 | X 49 2 | 3 3/4 | 31 5 5 | X 36 4 | 3 3/4 | 44 17 38 | X 61 2 | 3 3/4 | 51 9 11 | X 63 0 | 3 3/4 | | |
| " 21 | O 15 5 | X 20 30 | 1 4 1/2 | 22 17 9 | X 26 2 | 4 1/2 | 21 19 21 | X 43 5 | 4 1/2 | 44 19 19 | X 65 18 | 4 1/2 | 37 10 10 | X 47 16 | 4 1/2 | 25 21 16 | X 46 6 | 3 3/4 | 38 25 57 | X 63 2 | 3 3/4 | 11 6 43 | X 17 3 | 3 3/4 | | |
| " 28 | O 18 5 | X 23 38 | 2 4 1/2 | 10 16 11 | X 32 5 | 4 1/2 | 19 22 22 | X 48 7 | 4 1/2 | 44 14 36 | X 49 7 | 4 1/2 | 34 14 32 | X 48 11 | 4 1/2 | 3 16 16 | X 19 4 | 3 3/4 | 11 11 47 | X 68 9 | 3 3/4 | 9 6 49 | X 52 3 | 3 3/4 | | |
| March 7 | O 23 5 | X 29 32 | 4 4 1/2 | 11 16 15 | X 27 10 | 4 1/2 | 22 22 25 | X 41 7 | 4 1/2 | 44 16 23 | X 52 26 | 4 1/2 | 9 9 29 | X 41 9 | 4 1/2 | 4 5 18 | X 21 6 | 4 1/2 | 11 9 32 | X 56 5 | 3 3/4 | 6 11 44 | X 55 7 | 3 3/4 | | |
| " 14 | O 16 5 | X 19 30 | 6 4 1/2 | 22 15 21 | X 37 10 | 4 1/2 | 22 15 14 | X 47 14 | 4 1/2 | 44 10 20 | X 33 19 | 4 1/2 | 9 15 31 | X 38 20 | 4 1/2 | 2 16 5 | X 20 14 | 4 1/2 | 11 10 29 | X 40 13 | 3 3/4 | 8 40 40 | X 54 5 | 3 3/4 | | |
| " 21 | O 14 5 | X 12 21 | 3 4 1/2 | 7 6 2 | X 28 11 | 4 1/2 | 15 14 14 | X 30 19 | 4 1/2 | 44 20 33 | X 40 23 | 4 1/2 | 15 31 9 | X 30 23 | 4 1/2 | 5 2 5 | X 21 12 | 4 1/2 | 11 29 33 | X 36 5 | 3 3/4 | 1 13 6 | X 44 6 | 3 3/4 | | |
| " 28 | O 18 5 | X 14 21 | 8 4 1/2 | 17 2 7 | X 23 11 | 4 1/2 | 16 14 14 | X 30 23 | 4 1/2 | 44 15 33 | X 48 38 | 4 1/2 | 9 31 9 | X 40 21 | 4 1/2 | 4 1 1 | X 23 8 | 4 1/2 | 11 29 33 | X 33 9 | 3 3/4 | 6 28 4 | X 49 9 | 3 3/4 | | |
| April 4 | O 10 5 | X 10 24 | 6 4 1/2 | 7 7 17 | X 27 16 | 4 1/2 | 16 11 11 | X 42 37 | 4 1/2 | 44 10 35 | X 40 43 | 4 1/2 | 8 7 28 | X 37 32 | 4 1/2 | 2 18 1 | X 17 12 | 4 1/2 | 11 29 33 | X 44 15 | 3 3/4 | 5 27 1 | X 33 9 | 3 3/4 | | |
| " 11 | O 19 5 | X 16 23 | 9 4 1/2 | 12 18 8 | X 29 9 | 4 1/2 | 17 13 13 | X 58 21 | 4 1/2 | 44 30 30 | X 43 33 | 4 1/2 | 7 25 3 | X 35 41 | 4 1/2 | 1 14 6 | X 19 13 | 3 3/4 | 11 32 4 | X 33 7 | 3 3/4 | 1 32 31 | X 31 5 | 3 3/4 | | |
| " 18 | O 12 5 | X 11 23 | 11 4 1/2 | 12 16 13 | X 30 13 | 4 1/2 | 15 6 6 | X 46 24 | 4 1/2 | 44 29 29 | X 40 35 | 4 1/2 | 5 23 3 | X 28 38 | 4 1/2 | 3 6 3 | X 17 19 | 3 3/4 | 11 20 11 | X 13 13 | 3 3/4 | 2 31 0 | X 31 10 | 3 3/4 | | |
| " 25 | O 11 5 | X 9 23 | 1 5 1/2 | 13 10 27 | X 29 9 | 4 1/2 | 26 11 11 | X 32 22 | 4 1/2 | 44 9 36 | X 38 42 | 4 1/2 | 3 28 3 | X 26 21 | 4 1/2 | 2 21 13 | X 9 25 | 4 1/2 | 11 8 28 | X 28 1 | 3 3/4 | 33 6 39 | X 34 12 | 3 3/4 | | |
| May 2 | O 9 5 | X 6 15 | 2 5 1/2 | 10 6 13 | X 37 14 | 4 1/2 | 14 12 12 | X 58 16 | 4 1/2 | 44 7 47 | X 43 21 | 4 1/2 | 4 6 44 | X 31 14 | 4 1/2 | 0 13 0 | X 23 26 | 4 1/2 | 11 33 44 | X 35 6 | 4 1/2 | 6 5 31 | X 39 5 | 3 3/4 | | |
| " 9 | O 15 5 | X 10 15 | 4 5 1/2 | 7 5 7 | X 34 7 | 4 1/2 | 12 12 12 | X 51 13 | 4 1/2 | 44 13 48 | X 53 16 | 4 1/2 | 8 8 44 | X 35 13 | 4 1/2 | 11 0 11 | X 13 13 | 3 3/4 | 11 28 31 | X 40 2 | 3 3/4 | 9 31 9 | X 44 5 | 3 3/4 | | |
| " 16 | O 10 5 | X 10 15 | 5 5 1/2 | 23 17 15 | X 20 4 | 4 1/2 | 16 13 13 | X 51 15 | 4 1/2 | 44 14 39 | X 61 21 | 3 3/4 | 5 40 5 | X 45 23 | 3 3/4 | 2 14 2 | X 17 16 | 3 3/4 | 11 31 31 | X 40 2 | 3 3/4 | 25 6 21 | X 40 9 | 3 3/4 | | |
| " 23 | O 9 5 | X 15 19 | 3 4 1/2 | 15 4 6 | X 40 2 | 4 1/2 | 13 13 13 | X 49 15 | 4 1/2 | 44 11 31 | X 53 12 | 3 3/4 | 5 30 5 | X 45 23 | 3 3/4 | 2 2 2 | X 16 16 | 3 3/4 | 11 16 16 | X 37 8 | 3 3/4 | 7 21 7 | X 28 5 | 3 3/4 | | |
| " 30 | O 1 5 | X 6 19 | 2 4 1/2 | 4 6 8 | X 19 4 | 4 1/2 | 13 13 13 | X 41 17 | 4 1/2 | 44 37 8 | X 42 19 | 3 3/4 | 5 4 32 | X 35 14 | 3 3/4 | 2 23 23 | X 16 13 | 3 3/4 | 11 17 3 | X 22 5 | 3 3/4 | 1 25 1 | X 28 6 | 3 3/4 | | |
| June 6 | O 6 5 | X 3 12 | 0 4 1/2 | 8 13 7 | X 14 2 | 4 1/2 | 15 11 11 | X 46 10 | 4 1/2 | 44 35 10 | X 45 20 | 3 3/4 | 4 10 10 | X 37 29 | 3 3/4 | 1 21 2 | X 24 22 | 3 3/4 | 11 34 3 | X 20 1 | 3 3/4 | 1 3 3 | X 29 6 | 3 3/4 | | |
| " 13 | O 3 5 | X 2 5 | 0 4 1/2 | 7 4 8 | X 20 4 | 4 1/2 | 16 30 30 | X 49 10 | 4 1/2 | 44 10 28 | X 45 20 | 3 3/4 | 10 38 38 | X 42 23 | 3 3/4 | 2 29 1 | X 23 9 | 3 3/4 | 11 27 3 | X 36 4 | 3 3/4 | 2 2 4 | X 40 7 | 4 1/2 | | |
| " 20 | O 2 5 | X 2 4 | 0 4 1/2 | 2 6 8 | X 11 1 | 4 1/2 | 19 19 19 | X 49 9 | 4 1/2 | 44 10 54 | X 38 17 | 3 3/4 | 9 34 2 | X 47 19 | 3 3/4 | 1 27 3 | X 30 10 | 3 3/4 | 11 19 3 | X 30 5 | 3 3/4 | 4 29 4 | X 31 5 | 3 3/4 | | |
| " 27 | O 2 5 | X 2 3 | 0 4 1/2 | 1 7 8 | X 15 1 | 4 1/2 | 23 18 15 | X 39 6 | 4 1/2 | 44 12 53 | X 66 34 | 3 3/4 | 2 54 6 | X 36 23 | 3 3/4 | 3 34 3 | X 30 9 | 3 3/4 | 11 22 3 | X 23 6 | 3 3/4 | 4 42 5 | X 33 9 | 3 3/4 | | |
| July 4 | O 4 5 | X 6 12 | 0 4 1/2 | 15 8 9 | X 26 0 | 4 1/2 | 25 13 25 | X 33 4 | 4 1/2 | 44 27 17 | X 70 26 | 3 3/4 | 6 51 9 | X 60 15 | 3 3/4 | 2 27 1 | X 36 9 | 3 3/4 | 11 23 3 | X 25 2 | 3 3/4 | 5 39 5 | X 44 8 | 3 3/4 | | |
| " 11 | O 10 5 | X 6 11 | 0 4 1/2 | 9 6 8 | X 20 1 | 4 1/2 | 13 25 26 | X 38 5 | 4 1/2 | 44 12 20 | X 39 15 | 4 1/2 | 9 37 9 | X 60 13 | 3 3/4 | 1 38 5 | X 28 8 | 3 3/4 | 11 23 3 | X 28 1 | 3 3/4 | 5 36 4 | X 44 4 | 3 3/4 | | |
| " 18 | O 5 5 | X 5 11 | 0 4 1/2 | 8 5 8 | X 21 0 | 4 1/2 | 20 20 20 | X 51 1 | 4 1/2 | 44 20 29 | X 62 12 | 4 1/2 | 9 38 8 | X 46 12 | 3 3/4 | 1 30 6 | X 13 6 | 3 3/4 | 11 24 6 | X 32 2 | 3 3/4 | 4 10 4 | X 44 5 | 3 3/4 | | |
| " 25 | O 6 5 | X 6 11 | 0 4 1/2 | 9 6 9 | X 20 0 | 4 1/2 | 29 29 23 | X 40 0 | 4 1/2 | 44 16 32 | X 45 5 | 4 1/2 | 8 64 25 | X 46 10 | 3 3/4 | 6 25 3 | X 35 9 | 3 3/4 | 11 16 5 | X 30 2 | 3 3/4 | 4 42 3 | X 44 5 | 3 3/4 | | |
| Aug. 1 | O 15 5 | X 15 16 | 0 4 1/2 | 16 11 11 | X 25 1 | 4 1/2 | 18 14 17 | X 41 1 | 4 1/2 | 44 22 51 | X 54 0 | 4 1/2 | 22 55 2 | X 85 4 | 3 3/4 | 3 23 23 | X 28 8 | 3 3/4 | 11 23 4 | X 21 0 | 3 3/4 | 3 27 3 | X 15 3 | 3 3/4 | | |
| " 8 | O 2 5 | X 2 9 | 0 4 1/2 | 2 2 12 | X 32 0 | 4 1/2 | 17 29 29 | X 61 0 | 4 1/2 | 44 24 55 | X 73 2 | 4 1/2 | 2 60 19 | X 57 6 | 3 3/4 | 2 29 7 | X 25 2 | 3 3/4 | 11 8 8 | X 31 1 | 3 3/4 | 2 40 1 | X 29 1 | 3 3/4 | | |
| " 15 | O 4 5 | X 4 16 | 0 4 1/2 | 2 17 13 | X 34 0 | 4 1/2 | 19 27 18 | X 48 0 | 4 1/2 | 44 30 65 | X 79 1 | 4 1/2 | 1 62 18 | X 79 9 | 3 3/4 | 7 33 5 | X 35 5 | 3 3/4 | 11 30 4 | X 36 0 | 3 3/4 | 1 37 11 | X 44 2 | 3 3/4 | | |
| " 22 | O 4 5 | X 6 17 | 0 4 1/2 | 4 17 14 | X 30 0 | 4 1/2 | 18 38 31 | X 45 0 | 4 1/2 | 44 13 59 | X 80 2 | 3 3/4 | 1 61 17 | X 80 2 | 3 3/4 | 5 33 3 | X 38 0 | 3 3/4 | 11 41 1 | X 39 1 | 3 3/4 | 5 52 4 | X 48 2 | 3 3/4 | | |
| " 29 | O 6 5 | X 15 21 | 0 4 1/2 | 14 21 37 | X 31 0 | 4 1/2 | 21 37 16 | X 50 0 | 4 1/2 | 44 16 59 | X 95 2 | 3 3/4 | 2 90 22 | X 78 2 | 3 3/4 | 2 27 8 | X 38 3 | 3 3/4 | 11 21 3 | X 48 0 | 3 3/4 | 9 4 9 | X 56 0 | 4 1/2 | | |
| Sept. 5 | O 13 5 | X 13 20 | 0 4 1/2 | 23 17 15 | X 44 0 | 4 1/2 | 19 35 23 | X 46 0 | 4 1/2 | 44 16 35 | X 75 6 | 3 3/4 | 3 80 23 | X 112 1 | 3 3/4 | 8 34 13 | X 35 0 | 3 3/4 | 11 28 9 | X 30 0 | 3 3/4 | 6 10 6 | X 61 0 | 4 1/2 | | |
| " 12 | O 11 5 | X 9 14 | 0 4 1/2 | 15 22 22 | X 32 0 | 4 1/2 | 32 32 32 | X 58 0 | 4 1/2 | 44 35 59 | X 100 3 | 3 3/4 | 75 75 31 | X 103 1 | 3 3/4 | 32 8 8 | X 47 2 | 3 3/4 | 11 10 10 | X 37 0 | 3 3/4 | 50 50 10 | X 46 0 | 4 1/2 | | |
| " 19 | O 16 5 | X 25 25 | 0 4 1/2 | 21 4 5 | X 43 0 | 4 1/2 | 32 4 5 | X 64 0 | 4 1/2 | 44 31 31 | X 90 1 | 4 1/2 | 31 31 31 | X 106 2 | 3 3/4 | 8 8 8 | X 40 2 | 3 3/4 | 11 6 6 | X 46 0 | 3 3/4 | 4 4 4 | X 60 0 | 4 1/2 | | |
| 32 weeks. | | 621 | 68 | | 911 | 138 | | 1495 | 306 | | 1789 | 541 | | 1692 | 497 | | | | 873 | 305 | | 1193 | 140 | | 1382 | 151 |

O for ordinaries. X for extra flayed. The black lines show date of Cessation of Sale of warbled hides in these classes.—Ed.

Messrs. Fry & Co., of Birmingham, gives particulars of the numbers of sound and warbled hides sold at one of the Birmingham markets, and the price each parcel sold at, from the beginning of the warbled season, *viz.*, February 14th, to the end, September 19th, in 1885.

These details, it will be seen, extend over a duration of thirty-two weeks, and include price per pound of 'ordinary' and 'extra-flayed' hide (marked down the third column as 'o' and 'x' respectively), as well as those which are warbled.

By casting the eye along the columns it will be seen that the first three heavy classes, namely, those of 95 lbs. and upwards, 85 to 94 lbs., and 75 to 84 lbs., which are all, or nearly all, ox-hides, do not suffer as much as the three following. These last—that is, the classes weighing 65 to 74 lbs., 56 to 64 lbs., and 55 lbs. and under—are principally heifer-hides, and are the greatest sufferers. Bulls' hides are stated, as a rule, to be also very much warbled, but as these are not what is termed 'thrown out,' but sold (sound and warbled) together, the proportion of warbled hide could not be given.

The following abstract of the larger tables is given for convenience of reference. The amount sold during the thirty-two weeks of sound and of warbled hides may thus be conveniently compared, together with the highest and lowest prices per pound of each. The sound hides include both the ordinary and the extra-flayed.

Abstract of Table, with particulars of different classes of Hides sold during warbled season of thirty-two weeks, from February 14th to September 19th, 1885.

| Weight and Description of Classes of Hides. | No. of Sound Hides. | Highest and Lowest Prices per lb. | No. of Warbled Hides. | Highest and Lowest Prices per lb. |
|---|---------------------|-----------------------------------|-----------------------|-----------------------------------|
| 95 lbs. and upwards | 621 | 5d. to 6d. | 68 | 4½d. to 5½d. |
| 85 lbs. to 94 lbs. ... | 911 | 4¾d. ,, 5¾d. | 138 | 4¾d. ,, 4¾d. |
| 75 ,, 84 ,, ... | 1495 | 4½d. ,, 5¾d. | 306 | 4d. ,, 4¾d. |
| 65 ,, 74 ,, ... | 1789 | 4d. ,, 4¾d. | 541 | 3¾d. ,, 4½d. |
| 56 ,, 64 ,, ... | 1692 | 3¾d. ,, 4¾d. | 497 | 3½d. ,, 4½d. |
| 55 lbs. and under ... | 873 | 3¾d. ,, 4¾d. | 305 | 3½d. ,, 4¾d. |
| Heavy cow-hides ... | 1193 | 3¾d. ,, 4¾d. | 140 | 3½d. ,, 4d. |
| Light cow-hides ... | 1382 | 3¾d. ,, 4¾d. | 151 | 3½d. ,, 3¾d. |
| Totals ... | 9956 | | 2146 | |

Careful study of the detailed (folding) tables is well worth while for those practically interested. They show the different time over which attack extends from February 14th, and that it certainly cannot be considered as stopping in July. We find it in the three lighter classes of hides as still present on September 19th, but it is worth some notice that three heavy classes did not contain warbled hides at a much earlier date. The heaviest ox-hides, 95 lbs. and upwards,

were free after May 30th, and the two others of these heavy classes were free (save two hides in one class and one in the other) respectively after June 27th and July 18th.

It may also be seen that sometimes, at what may be called the height of the warble season, the number of warbled hides exceeds that of the sound in some of the classes. On April 25th entries occur amongst the '65 to 74 lbs.' and the '55 lbs. and under' hides respectively, of sales of 42 warbled and 38 sound, and 25 warbled to 9 sound."

I was also favoured by the following valuable information from Messrs. Richard Markendale & Co., Manchester, which may stand as a very special example of the serious amount of the loss which is going forward. A return showing over 83,000 hides damaged by warble, and loss thereon of over £16,000 in one year, is a matter for serious consideration.

The return I am favoured with is as follows :--

"March 6th, 1889. Further to yours of January 14th, 1889, 72 numbers warbled, and loss of hides passing through this market in one year. We now have much pleasure in sending you the information.

"1888. Jan. to Dec. Number of hides, 250,740 total.
 " " " " 83,580 warbled.
 Loss on same, £16,716 for one year."

--MESSRS. RICHARD MARKENDALE & Co., Limited, Hide, Skin, and Fat Market, Manchester.

A glance at the sum totals of warbled hides, and calculations of loss thereon, will give some idea of the loss and waste of material that is going on, but very far from a full one. The returns show depreciation of market value, but it should also be considered (as pointed out by Messrs. Ramsey, of Glasgow, and Mr. Hill, President of the Sheffield Butchers' Company) that this loss is quite independent of the subsequent waste of money consequent on the expenses of manufacture of damaged material, which, when finished, may be useless for the purposes needed.

Messrs. Ramsey's approximate estimate of this gives about double the original loss on the injured hides as the amount thus wasted to the community,—that is, to the national wealth.

But further, although the bulk of the English hides are distributed from the hide-markets to the tanneries, there is still no small amount received directly by tanners from local farmers or butchers.

On my application to Messrs. C. & H. Hatton, of the Barton Tannery, Hereford, as to their estimate of the loss suffered by themselves from warble-injury, they drew my attention to this point, and added: —

“We venture to think it would be sufficient to state that one-half of the hides taken in by tanners direct from the butchers are warbled, and show an average loss of 5s. to 6s. each; this would, of course, show a rough estimate of some thousands of pounds in the United Kingdom, independently of the numbers declared from the markets, and we regret to say that many hides which are classed as perfect on the market* prove to be covered with minute warble-grubs when the flesh and hair are removed by the tanner.”

Various other communications were sent me from tanners as to amount of warble-presence in hides sent in, but these have been enough entered on under warble-effects in the preceding pages.

It may not, however, be out of place here to point out what great good could be done towards warble-prevention by exhibition of warbled hides. When the hide is on the animal the mischief is very much hidden by the hair; but when the hide is displayed after death, then its loathsome condition, with the maggots working in it, shows the state of the case. The farmer naturally is not likely to be forward to draw attention to his beast being warbled; the cattle salesman or auctioneer will (or too often will) declare anything to get a beast, whose back is well-nigh eaten up with so-called “rottenness” from maggots, off his hands; and for the butcher it would be no gaining speculation to show the fearfully disgusting state of hides, beneath which the backs were, in the words of Mr. Williams (tanner), of Haverfordwest, “a mass of jelly from warbles.” So the matter gets hushed up, but if the real state of the case could be shown it would be thoroughly desirable.

* “Classed as perfect on the market.” During the time when it was necessary I should examine the condition of hide personally, to ascertain what might be going on for myself, I was one day examining a newly-flayed warbled hide, shown me by a neighbouring butcher on a large scale, who worked a good deal for me on the matter of warble investigation; and, with the under side of the warbled hide before us, he showed me how to *pass a “grubby” hide* on the inspectors as perfect. The process was simple. Just with a penknife to make a little slit across the thin tissue covering the maggot; then a gentle pressure frees it, or allows it to come out; the puffed-up apparent swelling caused by the maggot-presence sinks down flat; and though I did not experiment myself enough to be sure of possibilities of deceiving the inspector, I should say that the plan was one which, if not known of, it might be well to draw attention to as practicable. It may be well to add that my informant was then a butcher doing a large business, and in communication with hide firms, but has now retired.—ED.

METHODS OF PREVENTION AND REMEDY.

The notes directly following refer to prevention of attack, or of the fly "striking," as it is called, by application of washes or dressings such as may make the coat of the animal obnoxious to the fly, or may destroy the vitality of the egg, or may kill the newly-hatched maggot; also the feeding-ground being where there is shelter—natural or artificial—when the fly is about, or where there is access to water.

The following notes confirm the opinion (brought forward, I believe, first by Bracy Clark, and held by many writers) *that the Warble Fly does not follow the cattle over water, consequently that allowing access to shallow pools is a great preservation from attack:—*

The first observation on these points was sent me by Mr. Henry Thompson, M.R.C.V.S., Aspatria, Cumberland:—"The amount of warbles on an animal and amount of warbled animals in a herd will be rather difficult to arrive at, but I would say from fifteen to twenty warbles on the back of each animal,—that is, grazing on lands well sheltered with trees; but where there are *good large ponds, and the animals go into the water and stand during the hottest part of the day, they are not so rife.* From what I can gather, as well as from observation, I find the Warble Fly will not cross any extent of water."

June 28th, 1884. "During the recent hot weather I have frequently seen my feeding bullocks suddenly gallop off, with their tails erect, and rush into the nearest water, where they seem to be less tormented by the flies."—J. B. SCOTT, Sutterton Grange, near Spalding.

"Our cattle do not suffer much, but then we have plenty of marshy ground close at hand, and a good deal of timber which affords shade."—Prof. W. FREAM, College of Agriculture, Downton (1884).

In a communication on warble prevention sent me by Mr. B. St. John Ackers, of Prinknash, Painswick, he mentioned regarding the cattle, "Those that are in sheds escape entirely with me."

The following note, sent me by Mr. W. E. Cattley, Edderton, Ross-shire, N.B., refers very specially to benefit (with one exception) from housing cattle as a preventive to attack:—"A lot of three-year-old heifers (black polls), which had not been housed last summer except in bad weather, were all affected. They have now calves at foot. The short-horn crosses used for the dairy, which had been kept in at night all the summer, were clear of warbles, except a three-year-old, which was always in the house at night."

Whilst I was still resident at Sedbury Park, Gloucestershire, I have seen our cows going at the swinging trot that shows fly attack in the exposed pastures, or in the park, but I never saw this in

one field where there was a thick open grove of oaks with a shed beneath it, within and around which the herd sheltered themselves and picked the hay which might be strewn about.—ED.

The following note refers to the above point, and likewise to *housing at night*, which may prove important relatively to some of the *Æstridæ* being exceedingly lively in the bright moonlight:—"I seldom get any warbles in my own young cattle, and I think from this cause, —that *they have sheds to run under during the summer, and are housed at night*, and have a good feed of cake," &c.—E. R. BERRY TORR, Westleigh House, Bideford.

It would be useful if we could have more notes on the above heads, for if water and tree protection are to be depended on as preventive of attack something might often be done to give this to the cattle simply by leaving gates open. It is not a question of making ponds, or building sheds, or going into expenses, but in many cases of letting the cattle have the benefit of what exists.

The following communication gives an example of an animal who, by special circumstances was feeding on tether where most of the herd were house-fed in hot weather, broke his tether and came straight home for protection on attack. The Warble Fly itself is seldom captured, but I was fortunate enough in the summer of 1887 to have two specimens sent to me by Mr. W. S. Richards, of Rathturret, Warrenpoint, Co. Down, Ireland. The first was forwarded on the 30th of June, with the observation:—"It seems that when the cattle hear it in the air they are off. It does not seem to do more than rest on the cattle for less than a second. My cows are docile; I can stand near them and watch. Bees of different kinds they took no notice of, but knew the hum of this insect." On the 17th of August Mr. Richards sent me the second very beautiful specimen, which was quite soft and uninjured when I received it. From the downy appearance the insect looked exceedingly like a good-sized bee (only with one instead of two pairs of wings), and the black band across the body between the wings, with a yellowish band before it, also the blackish band across the abdomen, and orange colour at the tip showed well (see figure, p. 1). Mr. Richards wrote accompanying, after alluding to my previous letter on Ox Warble Fly. "We have been since trying to catch some more, and, though we had several chases, only were able to get one this morning. . . . This one flew at the legs and flanks of a young Guernsey bull; he broke tether and came home, the fly still at him; we got them both. . . . All my cattle are on tethers, and house-fed by day in hot weather, excepting six before mentioned" (referred



OX WARBLE FLY.—
Fig. 5, p. 1 (repeated
to save trouble in refer-
ence).

to in Mr. Richards' letter), "which I had no room for and could not then sell."

It is worth remark, that where the cattle were from necessary circumstances, as above mentioned, more exposed to attack, the fly was so much more noticeable as to allow having several chases and two captures, and it was also mentioned that the few cattle that were free were so maddened by the fly as to leap a parapet wall for the purpose of getting into water, and *continued swimming about* in a reservoir nine feet deep, with their own good will, to avoid attack.

Summer Attack.

About four weeks after the maggots have been noticed leaving the backs of the cattle the summer attack from Warble Fly may be expected to begin, and to be great or small in amount according to the number of maggots which were allowed to live.

In the following notes of applications or treatment of the animals, which have been found to *prevent* attack, it will be seen that there are a few special points acted on. These are—*1st, applying mixtures of such a strong smell as may be obnoxious to the fly and overpower the attraction of the smell of the animal; 2nd, applications which would stick the fly fast or kill the egg; 3rd, washes which would clear off the eggs or destroy them if laid on the skin, or kill the grub whilst near the surface; 4th, protection afforded to cattle by being housed at egg-laying time.*

"Respecting the application of anything to prevent the Warble Fly depositing the eggs, there are a number of matters of a tarry nature that might be applied, and nothing better than Stockholm or green tar itself rubbed along the cows' backs before turning them out, which would last all the summer season, or applied in May or June between the top of the shoulder-blade and loins. This is the only part the cow cannot lick, rub, or lash with the tail; hence the only *peaceable* place where the fly can leave its egg. Or sheep-salve (bad butter and tar mixed with sulphur). About two applications would last a full season. Or the application of brine and the mixture I have already given you. Paraffin, kerosine, carbolic acid, phenyle, &c., are all too transient to be of much service, and would have to be applied frequently."—H. THOMPSON, M.R.C.V.S., *Aspatria* (1884).

Mr. Thompson further noted that he had been told it was a common practice to wash the cows' backs with pickling brine, the application being used two or three times during the season. In this part large farmers keep what is called the pickling-tub, wherein they put beef and mutton; the brine is made with salt and water, salt being added till an egg will float. This is an old remedy, and I think a good one, as I think the ova would be destroyed immediately it was placed in the skin.

“I have used and also recommend the following mixtures as a preventive:—Flour of sulphur, 4 oz.; spirits of tar, 1 gill; train (whale) oil, 1 quart. Mix well together, and apply along the spine of the cow once a week with a small brush. The smell drives off the flies, and prevents them depositing their eggs, and the cattle are left *at peace* to graze, and warbles thus prevented.”—HENRY THOMPSON, Aspatia.

“I venture to give my experience of many years. If cattle that are turned out into the fields (those that are in sheds escape entirely with me) are rubbed all down the spine with train oil, and a little also on the loins and ribs, they will be free from this pest, have their hides uninjured, will do much better, and will graze quietly at the time that others not so treated are tearing about with their tails in the air.

“Two or three dressings I generally find enough, but much depends on the season and the thickness of the ‘coat.’”—B. ST. JOHN ACKERS, Prinknash Park, Painswick.

“I should have written you before as to the effect of dressing for fly, but thought I would wait and make quite sure as to the results. I prepared mixture as you recommended, *id est*, 4 oz. flower of sulphur, 1 gill spirits of tar, and 1 quart of train oil, and applied the same to sixteen beasts. The effect was very marked; previously they had been galloping about all the day, continually getting out of the field and giving much trouble thereby; since not one of them has got out, and the men who were making hay in adjoining fields, and had full opportunity of watching them, tell me that *since being dressed they have scarcely run about at all*. I have since applied the same mixture to the whole of the beasts on my farm, and am so well satisfied with this application that I have not tried either of the other receipts.”—H. J. HILLARD, Helland, North Curry, Taunton.

“I am glad to say my cattle have to my knowledge only once been disturbed through this very hot weather. I have dressed this year with sulphur and train oil, which I see you recommended.”—W. DAVIDSON, Lower Green, Acton, Northwich.

“I had each cow dusted along the back with sulphur. The result is that only two cows had one solitary deposit each; the others were perfectly free, whilst there are several on the backs of their calves. To those deposits I have used carbolic acid mixed with hog’s lard, in the proportion of one to twenty, with excellent effect.”—T. DUCKHAM, Baysham Court, Ross.

“I promised to write you again regarding dressing cattle against the Warble Fly. My experience at present is that they lie much quieter in the fields, and appear far more contented, after being dressed than without. I dressed them with McDougall’s Smear, and then

powdered them over with flour of sulphur."—T. ROGERS, *The Homme, Dilwyn, Leominster.*

"As a preventative from attack we rubbed a quantity of dry sulphur upon the back of our dairy cattle, from the shoulder to hip on each side of the spine, and a little on the brisket. We believe the sulphur had the desired effect, as our cattle were quiet in their pastures, while I could see some herds near were much tormented. The dressing was repeated frequently; the brisket was dressed to keep the Gad Fly away. We used sulphur as being free from smell, and not liable to taint the milk."—DAVID BYRD, *Tarporley, Cheshire.*

"For many years I have used a weak solution of McDougall's sheep-dip, and have found it keep my grazing cattle perfectly quiet in the hottest day. We drive the cattle to a corner and keep them jammed close together by the dog, whilst the man sprinkles them with a common garden watering-pot with a rose on the spout. This is done every week if the weather is wet, otherwise about every ten days."—H. LINDSAY CARNEGIE, *Kinblethmont, Arbroath, Nov. 13.*

On looking over the preventatives for attack, the sulphur, or sulphur, tar, and train oil, mixtures appear to be most approved; but the frequent mention that where the warble-maggots had been destroyed the herds rested at peace is a matter that calls for careful consideration. I give only a few words on this here, as the subject occurs further on under heading of remedial measures. But in a communication from Mr. Stratton, of *The Duffryn, Newport, in 1884*, he mentioned:—" . . . Here, where I had all the warbles destroyed, I have observed only one animal running from fly so far, though in other years they have suffered badly enough. This looks like the effect of treatment, and, if so, indicates that the fly does not go far from its birthplace "

The following observation bears on the same subject:—

"Regarding the Ox Bot Fly, I may say that I have had none on my farm for at least ten years. My cattle are now never seen, with tails erected, running as fast as their feet can carry them. Purchased animals generally have these warbles in their backs; these we take good care to take out by making a small opening with a penknife and pressing out the worms. Thus we do not have the Bot Fly, neither does it seem to come from other farms."—JOHN MILNE, *Mains of Laithers, Turriff, Aberdeenshire.*

*A few remarks should perhaps here be given on the Ox Gad Fly, *Tabanus bovinus*, as, although this insect differs in every point as of size, appearance, and habits, in all its stages from the Warble Fly, its attacks cause severe pain, and in neighbourhoods frequented by the*

fly, the galloping of the cattle is as bad from this cause as from Warble Fly presence.

The Ox Gad Fly, figured below, life size, is very much larger than the Warble Fly, and is mostly brown or bees-wax colour; the abdomen handsomely banded across with alternate brown and tawny yellow. This fly does mischief by piercing into the hide with the sharp knife- or lancet-like apparatus, enclosed in its proboscis, possessed by the female, and sucking away the blood. This is a great distinction



Tabanus bovinus, "Ox Gad Fly"; side view, showing proboscis.

between the Gad Fly and the Warble Fly, which has nothing that can be called a feeding-mouth.

The two kinds of flies differ also in their early stages. The maggot of the Gad Fly *never lives in the hides of cattle*. It lives in the ground, something in the manner of the Daddy Longlegs grub, and, somewhat similarly, is long and cylindrical, and it has a shining brown elongated head. The chrysalis is long and somewhat cylindrical, and both in development and pupation these Gad Flies resemble the Daddy Longlegs. The buzz of this great fly is described as a kind of heavy, droning, intense noise, easily known when it has once been heard.

I believe this fly not to be very common in England, and I have only rarely received specimens; but it is sometimes greatly confused with the Warble Fly, without the slightest regard to its very name showing the difference of possession of the "mouth-gads," or prickers, which are such a clear distinction, and therefore it seems desirable to mention it.

As far as we are aware, the same deterrent dressings which are useful against the Warble Fly serve equally well against this Gad Fly. It will be observed that in the remarks by Mr. David Byrd, at p. 44, he mentions, "The brisket was dressed to keep the Gad Fly away."

METHODS OF DESTROYING THE WARBLE-MAGGOT IN THE HIDE.

When the warble-swelling has "ripened," as it is called (that is, has opened so that the two black specks at the end of the tail of the maggot are visible), then it can be destroyed easily and cheaply by so many kinds of applications, or kinds of treatment, that it is difficult to arrange them in some sort of order for reference.

Where the maggot can be squeezed out, this is probably the very best plan of all. The grub is thus cleared out bodily,—quite got rid of,—the filthy fluid in the hole oozes out, the cavity draws together in somewhere about three weeks (where we have the date of healing given), and, excepting that the false skin (see p. 13) remains for a while in the opening, and that there will always be more or less of a scar or injured condition of the spot, the work is complete. But it is not always possible to manage this squeezing out; the maggot may not be advanced enough to come away, and later on, where attack is bad, the back may be too sore to bear handling.

For such conditions, dressings or applications to the entrance-hole of the warble are needed, and all that is wanted is something that will stifle the maggot by choking up the breathing-pores at the end of its tail, or that will poison it by running down into the warble-cell where the maggot is lying mouth-end downward, and, mixing with the fluid which it sucks in, thus poison it.

Amongst the many applications of which we have notes of success on sound authority, I think the only really poisonous one advised is mercurial ointment, and observations have been sent in, of which several are given below, of the safe and successful use of mercurial ointment for killing the maggot in the warble from various cattle-owners and others who have used it up to the amount of application to 250 head in a herd of 800 cattle.

In these cases the ointment has been used in the manner I have always most carefully advised, namely, *only as a small touch on the opening of the warble*. By *no means* as a large dab, *nor* as a smear, *nor* (where warbles were gradually appearing or were numerous) as an application to be made repeatedly over a large surface of warbled hide.*

The first communication on this subject was sent me from Mr. R. Stratton, of The Duffryn, Newport, Mon., on April 11th, 1884, with a few remarks on some other remedies:—

"I have treated some warbles with acetic acid, some with tar, and

* Only one instance has ever been reported to me of ill effects, and in this case the ointment was *not* applied according to directions, but the animal, which was suffering to a quite unusual extent from warbles, was smeared along from head to tail. Details, comments, and opinions thereon will be found in the 'Agricultural Gazette,' Nos. 598, 599, and 601 (1885).

some with *mercurial ointment*; I have not the slightest doubt but that all will be effectual. I am satisfied there will be no difficulty in killing the grub with any one of fifty simple remedies."

About a week later Mr. Stratton added:—"I treated others with *mercurial ointment* (such as is used for scab in sheep); the effect of this is very remarkable, for in a couple of days after the application the grub appears to be quite decomposed; and I am persuaded that no remedy can be more safe, simple, and effectual than this. It would not cost twopence a head to treat all the cattle in the country in this way.

"It is quite easy to destroy the grub by a stab, but the cattle object to it; it appears to hurt them almost as much as a puncture through the skin. The objection to the scalpel, &c., is that when you treat an animal for this attack all the grubs are not in the same stage, and some have no orifice developed, or only a small one, through which it would be difficult to make an insertion; whereas, whether visible or not, a little of the ointment rubbed in would destroy the grub effectually.

"Tar had the desired effect in every case but one, and in that I think the hair kept it from the opening. Acetic acid was perfectly effective."—R. STRATTON, The Duffryn, Newport, Mon.

Other notes of approval of the application were sent in, from which I have chosen the following, as being from large cattle-owners, or, in the first instance, from Professor Riley, who has given special study, practical as well as scientific, to warble-treatment:—

"In America it has been found that a little *mercurial ointment* applied to the swellings in autumn acts very well in killing the young *Hypoderma* larva, but the simpler and equally effectual way is to rub the back and sides, and especially the back, with pure kerosine oil."—Prof. C. V. RILEY, Consulting Entomologist, Department of Agriculture, Washington, U.S.A.

"The smallest quantity of *mercurial ointment* (as much as a small pea) placed on the hole in the skin carries death within twenty-four hours. After applying the ointment to about forty-five cows, I cannot tell exactly the numbers that were in the cows' backs, but my impression is that there were seldom more than six in one beast."—E. E. McBRIDE, Glendonagh, Middleton, Co. Cork.

"June 10th, 1885. Resulting from your advice, I have within two months dressed about 250 head of cattle out of 800 with mercurial ointment for warble-maggots with speedy and complete success, and without any bad effect whatever. My herdsmen all now swear by your remedy; but I think at a very early period in spring, dressing down the backbone with sulphur might be a great prevention also."—J. A. FARRELL, Esq., D.L., Moynalty, Kells, Co. Meath, Ireland.

“ We put the mercurial ointment on to the swellings this year, and I was much pleased with the effect, as the cattle were certainly much smoother than last year.”—Colonel G. COUSSMAKER, Westwood, Guildford.

“ I have used the mercurial ointment on several beasts, and in most instances the grub has been killed. I am going to dress again the lumps where there seems to be a grub alive.”—Hon. CECIL PARKER, Eaton Estate Office, Ecclestone, Chester.

“ After reading Miss Ormerod’s pamphlet on the subject, I sent for some mercurial ointment, both blue and yellow, and got the bailiff to apply it at once, as most of our cattle were infested with warbles. This he did by putting a small quantity sufficient to cover each hole, and slightly rubbing it in, and I believe in every case it had the desired effect. It either choked or poisoned the maggots, for on pressing the warbles a few days afterwards it was evident they were killed and decomposed, as nothing but a yellowish matter came from the sores. Both ointments appeared equally efficacious, and no harm resulted to the cattle from its use. I intend to renew the treatment next year.”—T. A. SUTTON, Yew Tree Farm, Tarporley, Cheshire.

To the above I venture to add some parts of a letter by Dr. G. Fleming, which he was good enough to write me on my laying the details of the case above alluded to before him, and also permitted me to give in the ‘Agricultural Gazette’ (see reference in note, p. 46).

“ With regard to the cases of supposed poisoning of cattle in Cornwall, I cannot understand how such an accident could happen, unless your instructions were ignored, and the animals were smeared and rubbed with a large quantity of the ointment.” . . . “ You recommend destroying the maggot of the Warble Fly *by just touching it with a little mercurial ointment, such as is used for scab in sheep.* . . . ”

Dr. Fleming went into all the points *seriatim* of the illness and death of the animal, which was ascribed to treatment with mercurial ointment, giving details as to amount and effects of action of mercurial ointment, all which will be found in ‘Agricultural Gazette,’ as referred to; and ended the long consideration he was so good as to place in my hands with this sentence:—“ I am confident that no ill-effects can arise if your directions are followed with anything like ordinary care.”—G. FLEMING, LL.D., F.R.C.V.S.

If used under proper superintendence, and according to direction, mercurial ointment is a safe and serviceable remedy; but, seeing the liability there is to carelessness and misunderstanding in the matter, in my later leaflets on Warble Fly I have only slightly alluded to the application, thus:—“ Mercurial ointment answers, if carefully used—that is, in very small quantity, and only applied *once* as a *small* touch on the warble; but where there is any risk of careless application it should not be used.”

Where cattle are suffering badly from warbles, so that the health is clearly affected, and the animal wasting, the use of the well-known old "black oils" has been found to do much good.

Mr. Henry Thompson, M.R.C.V.S., of Aspatria, Cumberland, gives the following recipe used for a bad case:—

"Last year about this time I was called in to a little three-year-old heifer whose back was almost covered with warbles, and the effect on the constitution was very marked; the poor thing was very thin, and would not eat. I was satisfied that the irritation set up by the warbles was the cause, and applied the following:—Turpentine, 1½ oz.; sulphuric acid, 1 drachm (here a chemical action takes place, and it must be done with caution). To this I added 10 oz. raw linseed-oil, and rubbed the cow's back once a day with the mixture.

"In a fortnight the back was cleaned, and all the maggots destroyed." — HENRY THOMPSON, M.R.C.V.S., Aspatria, Cumberland, April 11th, 1887.

Where neither proper advice nor more elaborate applications are at hand, lard or rancid butter, mixed with a little sulphur, or cart-grease (if not of too strong a kind), also mixed with a little sulphur, have been found to succeed well; and, as shown in the following observation, the butter or lard will answer well in very bad cases, by being soothing in effect, as well as destructive to the maggot, and this, as will be seen, safely and satisfactorily in about the most ignorant and untrustworthy hands that could be found.

In 1885 a communication was sent me by Mr. P. M'Hale Greer, Ballycastle, Co. Mayo, Ireland, to the effect that when the cattle were severely affected by warbles, it was a common practice to take them to the charmers, who in some way or other killed the maggots:—

"In the barren and bleak districts of West Connaught, exposed to the searching rays of the sun, and without stream or pond, tree or bush, to afford coolness or shade, the hardy mountain cattle suffer to an alarming extent from the ravages of the Warble Fly when laying its eggs. The tract of country through which some of these poor animals career is often surprising. It extends to miles, and eventually causes their owners no little trouble and expense to bring them back again. The injury done to the animals themselves from exhaustion during the summer, and from irritation in the winter, is so great that many a strong and healthy animal becomes languid, unable to eat, and unable consequently to thrive. These cattle have not been properly housed, and oftener than not half-fed, and the warble-maggot develops with extraordinary rapidity and to a large size. The larger the maggot grows the more pus it requires for its support, so that, what with insufficient food and the great annoyance caused, the cow becomes a fit subject for the 'charmer' and her spells. She is generally an

old woman, and the methods of procedure are very simple. When she enters the stable of the sick cow she calls for some butter or lard. After it has been placed before her she prays for a time to some spirit (that I wot not of, nor could I find out). After the spirit of destruction is exorcised she takes the butter, and gently covers the breathing aperture of the maggot and crosses it. The result of all this is that the maggots die, and fall, or are easily picked out, without causing the least pain. I know not what good the incantations of the 'charmer' may have exercised, but a little butter or lard, and I should say a small quantity of sulphur (I believe the 'charmings' use sulphur), laid on as we have seen, will leave a warble-less hide."—P. M'HALE GREER.

As the "charmings" require a good sum for their services, I felt sure that the remedy must be one that acted, as well as something very simple, and therefore obtained a quiet investigation, with the above results.

Lard and butter answer well as being soothing, in addition to their direct effect in killing the maggot, and so does "cart-grease," if there are no irritating ingredients in it; but some of the mixtures sold under this or similar names, as "axle-grease" or "railway grease," are too irritating in their action to be safely applied excepting with care, and (till the action is known) watching as to effects.

The above applications are especially useful in their different ways where the back is too tender to be touched; but lard or rancid butter is not always at hand, and for regular work the smears and dips, of which so many kinds are furnished by many well-known firms, are the most commonly used.

Destruction of warble-maggots by application of smears or dressings or washes.—It should be carefully kept before the minds of herdsmen, with regard both to dressings to keep fly off and to destroy maggots, that—though the effect of some kinds lasts a long time—it is often almost waste money just to run the animal over with some wash of which the effect soon goes off.

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

* This of course does not apply to washes of brine, which are sometimes very useful.

In the following notes observations have been chosen from great numbers, just to show the variety of applications that answer, and that various firms furnish them; but readers will please observe that this is without prejudice of others, whose manufactures, so long as the above-mentioned conditions of the dressing were held to, and due care exercised in applying them, could not fail to have good effects.

The following observations, with which I was favoured on June 5th, by Mr. Gerard Meynell (of the Norfolk Estuary Company), writing from 20, Whitehall Place, London, S.W., refer to the successful use of Calvert's carbolic sheep-wash for destroying warble-maggot:—

“For some years past the sheep on this Company's farm at Lynn have been dipped in a solution of Messrs. F. C. Calvert & Co.'s carbolic sheep-wash,—80 to 100 of water to 1 of the carbolic wash supplied,—which has effectually kept them free from all scab, lice, ticks, fleas, &c. Last week I examined the Company's herd, and found some of them affected with warbles. I had a somewhat stronger solution of the carbolic sheep-wash applied to the parts affected. On the following day all the warbles appeared to be dead; the more mature ones certainly were so” (1888, as also the three following notes).

Mr. J. Stewart Peter, of Calley, Bridge of Calley, Perthshire, on June 20th, sent me the following note, suggestive of dilute carbolic acid being in some cases better than greasy applications:—

“I have dressed a number of short-horn crosses as directed, and feel sure that they will derive great benefit from it. I rather object to dressing my West Highlanders, though, with an oily or greasy mixture, as it will mat their shaggy hair, and prejudice the English buyers against them when they come north in November. I think for them carbolic acid and water ought to suffice.”

The two following observations refer to successful use of ointment prepared by the Dee Oil Company, Chester. The first was forwarded to me by Sir James T. Stewart Richardson, Bart., of Pitfour Castle, Perth, N.B.:—

“I have been trying a new warble ointment this summer, from the Dee Oil Company, Chester, and the effect on the maggots in the warbles was marvellous, and I am now dressing all my cattle to prevent the fly striking next month.”

Miss Lyle Smith, writing from Barrowmore Farm, Chester, also sent the following note:—

“You may be interested to know that the Dee Oil Company, in Chester, prepare a kind of grease of which they send samples gratis to any farmer who will try it. I found it most efficacious, as did also a neighbour, who had lost a heifer simply from attack of this creature [warble-maggot—ED.] in the spring.”

The following reports are a few of the observations sent me of successful use of Messrs. McDougall's preparations :—

“My cattle have been very much troubled with warbles. The summer before last, in the end of May, I dressed them with McDougall's sheep-dip, repeating the dressing occasionally till the end of August. The result was most satisfactory, *as the next year they were almost free from them.* I shall in consequence always continue to dress them so.”
—JOHN M. MOUBRAY, Broom Court, Alcester (1886).

“I always notice that bought cattle, and especially those from Wales and the West Country, are more affected with warbles than our own. I am strongly of opinion that the best way of killing the grub is to rub some unguent on the surface of the lump-hole in spring. An old friend of mine always used McDougall's sheep-dip preparation for this purpose with good effect. This method, of course, leaves the hide injured by holes. If there is any chance, however, of exterminating the fly, it is a feasible and right method.”—Prof. H. J. LITTLE.

In 1885, Mr. David Byrd, writing from Spurstow Hall, Tarporley, Cheshire, mentioned :—“I am glad to say that we found McDougall's smear effectually killed the warble-grubs. The mode of dressing we adopted was to shape a piece of wood or stick like a knife-blade with a point. We searched carefully for the warble-hole, leaving a good portion of the smear on the warble; this appeared to completely choke up and kill the maggot. The mode of dressing to kill the warble was not painful to the cattle; those that were quiet appeared to like the friction.”

On June 27th, 1888, Mr. Saml. R. Sherwood, of Hazlewood Hall, Friston, Saxmundham, wrote :—

“I caught all my cattle a few days since and dressed them with McDougall's smear for bots, and only wish I had done it before;” and on the same day Mr. G. Thomas, of Coosenwartha, Scorrier, Cornwall, wrote that, “thanks to the advice and use of preventives, my cattle are entirely free from warbles, and I shall never allow them to go undressed again.

“I found wheel-grease too strong, as it blistered. McDougall's dip proved excellent, but it is difficult to procure here as there are no agents.”

The following note, sent me on July 5th by Mr. John Watson, jun., from the Estate Office, Sherburn, near Tetsworth, also mentions serviceableness of McDougall's smear :—

“I have been making use of your advice about warbles with most satisfactory results. McDougall's smear is an excellent cure as well as preventive, and I am sure the trouble and expense is well repaid by the increase in the animals' comfort.”

On June 21st, 1889, Mr. G. F. Street, writing from Maulden, Ampthill, observed:—"Warbles are getting quite stamped out now on our two farms, as for the past three years we have not had on an average one dozen warbles on from sixty to seventy head of cattle, mostly young stock. We always use the McDougall's smear, and find it a safe remedy."—G. F. S.

In a letter from Messrs. J. R. and R. R. Kirkham, of Biscathorpe, Lincoln, the Warble Fly paste, manufactured by Messrs. Tomlinson and Hayward, of Lincoln, is mentioned as very efficacious, not only by preventing the fly striking (if put on in time), but, if this has not been the case, by killing the maggot. This paste is mentioned as better than a liquid cure, for it is easier to use, adheres much longer on the cattle's back, and is not so easily washed off by the rain (1894).

The following report from Mr. F. C. Smith, of Clayton Park Square, Newcastle-on-Tyne, who bestowed much time and trouble on drawing attention to the subject of warble prevention, was sent me on June 4th, 1888:—

"I lately met Mr. James Renton, tenant of North and South Brackley farms, near Blagdon, to whom I gave a copy of your notes about a year ago, and who then told me that his stock—numbering about forty head—were infested with warbles. He forthwith commenced to use a dressing* composed of train oil and sulphur, of the consistence of thick cream, which he applied to the warbles with most excellent results; and later on, in August, he dressed them with the same preparation,—over the shoulders, and along the spine, and down to the hocks."

He reports that *no* warbles are upon stock of his own breeding, although he has had much trouble with *Irish* stock brought to fatten off; and that many of his neighbours are in a bad way with their stock suffering from warbles, and these people are now going to adopt the same remedial measures as my informant has proved to be so effectual.

On June 14th Mr. Ernest Mead, who had communicated with me before on the subject of warbles, from 1, Western Road, Tring, wrote as the result of his application of oil and sulphur to the back of cattle in the previous summer:—

"As regards some three-year-old bullocks that were dressed, I have kept some of them till quite recently. After examining them several times I have not seen a trace of warble."

Relatively to the effect of salt in destroying the maggots, Mr. Edw. Argyle, writing from Tamworth, with the mention that he was an

* Mr. Renton says that a gallon of train oil, costing three shillings, and sulphur, costing say threepence, was sufficient to dress thirty-two head once.

amateur breeder and keeper of stock, noted as a report of the success of his treatment in 1889 :—"I am glad to say that I believe the fly has not been anything like so troublesome about here this season as it has usually been. I have never seen my cattle at all distressed by it. I may mention that I have employed common salt for the destruction of the grub this season with good results. I bought some young cattle of very nice quality in the early summer; they were terribly infested with grubs. I had their backs damped, and salt well rubbed in, and this was repeated about a week later. The result was that every grub was destroyed."

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

In the foregoing pages observations are given of various easy methods of destroying the Warble Fly maggot by stifling it in its cell, poisoning it, &c.; but there is yet another method which, when circumstances allow (such as condition of the hide, and open state of warble), is probably the best of all, namely, squeezing out the maggot, and thus getting entirely rid of it at once.

This requires no outlay in mixtures, no trouble in looking them up, and careful application of them when needed, but is what may be done by any man or boy on the farm, and which commonly (especially in the case of the boys) they enjoy doing. Where care is bestowed on the subject, squeezing out may usefully follow on killing by smears, &c., in the hide, and healing up happen sooner, and also there will be proof that the work was thoroughly done.

During the whole course of our ten years' work we have been kept constantly aware of the success of the plan acted on (that is, destroying in the maggot form) preventing recurrence of attack. It is obvious indeed that if it had not answered, the plan would not have been gone on with, and in the preceding pages reports of the success of this have been given; but I just add a few below, received in 1889 (taken from many others), regarding benefit obtained.

The following note, with which I was favoured on September 21st

by the Hon. Cecil Parker, from the Eaton Estate Office, Eccleston, Chester, also mentions the attack having been nearly got rid of:—"I am quite sure that more notice has been taken of the means of destroying the warble. As far as our own cattle are concerned, we have nearly exterminated them by killing the maggot in the beast, and also by smearing the backs of the stock twice in the season. If the farmers could be persuaded that they lose money,—in cows by the milk getting less, and by the beasts losing flesh,—they would take more interest" (1889, as also three following notes).

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

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

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

These show success in the special localities reported from; but the manner in which, by steady quiet attention, the warble-presence in the cattle-farming district round Bunbury and Tarporley was reduced from its enormous prevalence a few years ago down to the result of most careful search only bringing in twenty maggots, is a very important record.

This has been the work of the boys of the Aldersey Grammar School at Bunbury, Tarporley, Cheshire, at first under the suggestion and instruction of the Head Master, Mr. W. Bailey, but now continued also from the benefit accruing to the cattle and thence to their owners.

The majority of the boys of the school are sons of farmers, and the returns therefore show the benefit of the treatment, whether on the broad scale of the many head of cattle owned by tenants of large farms under the Duke of Westminster or other great land-owners, or to the one or two cows of a small holder, to whom the health of his animals is even more important.

We (I can say *we*, as I had the pleasure of co-operating with Mr.

Bailey in his work) did not go into scientific points, nor was the work in any way compulsory. In 1885 the boys were shown the warbles, told their history, and begged to bring what they could find; amongst them, one pupil alone brought in 250, and in the *following year*, when he examined his father's and his brother's stock (numbering 114 head of cattle), *he found no warbles*, excepting on young cattle which had not been dressed because they were out in the fields.

So year by year the work continued. The boys examined the cattle at the time when the maggots were beginning to be in a state to remove, and brought them in to Mr. Bailey, who noted numbers and details, and gave me the results yearly in tabulated form until the pest was nearly stamped out. These gave in separate columns the names of the finders, the number of stock examined,—ranging in the table before me from a single cow up to eighty-six,—and also the amount of warbles on cow, calf, or heifers. From these tables and notes the steady and immediate drop in amount of warble-presence where care was taken was clearly shown, and also the immediate running-up of numbers where uncared-for cattle had been brought in, or from some cause there had been difficulty in giving the necessary attention.

Relatively to this point, on April 13th, 1887, Mr. Bailey informed me:—"Another lot of boys have examined and reported to me on 250 head of stock. The results agree with those I sent you.

"Where the cattle were properly attended to last year by the warble-maggots being squeezed out, or dressed with McDougall's smear or cart-grease, there are scarcely any maggots to be seen now; where, however, this precaution has not been taken, the enemy is to be found in full force."

As examples of the former, Mr. Bailey mentioned two of the boys, who had paid great attention to the matter in the previous year, and had (at time of report) examined, respectively, one 58, the other 53 cows and heifers; in the first case finding only *one* warble, in the other only *six*.

"On the other side, where remedies had not been applied, two brothers removed 40 maggots this week from one stock, and their task is not half done; another boy applied McDougall's smear to 70 warble-maggots.

"It is not only on our large farms where so much energy is being shown in an effort to stamp out this pest, but the sons of our cottagers are equally active in the cause. These boys in a few years will be our agricultural labourers, and I encourage them to examine and report to me on their one cow and heifer.

"Where the stock is free from the pest the boys tell me the cows are milking unusually well this year." . . . "I have no hesitation in

saying that in this parish alone what has been done at your suggestion has put many pounds into our farmers' pockets, for their stocks are giving more milk, and are feeding better. The hides also are worth more money."—W. B.

I have given the above at length as the work being done under the eyes of Mr. Bailey, and likewise of Mr. D. Byrd, of Bunbury Heath, and many of the other farmers of the neighbourhood: it is no mere fancy or half-proved experiment, but what could be judged of by all connected with the stock in the district, and it shows not only the benefit of getting rid of warble-grubs, and the thoroughness with which they can be cleared out of a district, but the benefit of plain common-sense instruction on the subject of farm-insect pests.

The work was carried on with the full approbation of the Haberdashers' Company, to which the Aldersey Grammar Schools belong; also it was considered so satisfactory that an account of it, written by Mr. Bailey to His Grace the Duke of Westminster, was read by the Hon. Cecil Parker before one of the Committees of the Royal Agricultural Society of England in 1887, and recommended for publication; and the work since has been equally satisfactory.

The treatment, so far as I am aware, was wholly either squeezing out the maggots, or killing them by cart-grease, or application of the ointments prepared by Messrs. McDougall Brothers, the Dee Oil Company, Chester, and Jeyes' Sanitary Compounds Company (Limited), the effect in the case of all the dressings being very satisfactory.

Last year (1893) the result of the spring search produced scarcely any maggots, and in this year Mr. Bailey, writing to me on the 6th of November (that is, the 6th inst.), reported, in reply to my enquiries, as follows:—

"The specimens brought to me this season, notwithstanding a most diligent search, have been so few that I think we may now claim that, in this parish, the pest is practically stamped out. The total number of warble-maggots found by the boys did not exceed a score, although special marks were given for every maggot brought, and the contest between some of the boys for the prizes which you so kindly give was very keen.

"If you will refer to my report to you in 1889—*only five years ago*—you will notice that 577 head of cattle were then examined by the boys, and that no fewer than 1077 maggots had been squeezed out and destroyed by them, or killed by the application of smears." . . . "The farmers in this district are fully alive to the importance of this duty. Stocks are regularly and carefully overlooked, and cattle bought at fairs or elsewhere are specially examined."—W. B.

During the present year the application to myself for information regarding special cases of infestation, papers for publication, and for leaflets has in no way lessened: for, on reference to my letter-book, I find it began on the 2nd of January, and continued at intervals to the 20th of April. From that date, until the 8th of June, hardly a day occurred without applications regarding warble, sometimes amounting to as many as five, eight, or ten per diem; and since then, though not as frequently, the applications have continued until within a few days of the date of writing, Nov. 9th.

As many of the applications have been for leaflets for distribution, it may be hoped that information is gaining ground; and one marked advance in the past season has been the number of applications from Ireland, from localities in nearly all the Irish counties. The simple methods of treatment continue to be approved wherever they are carried out with any sort of care.

SUMMARY.

The information in the preceding abstract is almost entirely taken from reports sent me from British and Irish observers, and colleagues in the work, and published in my Annual Reports on Injurious Insects from the year 1884 to 1890 inclusive. Of these the first—that for 1884—deals with as much of the history of the infestation and means of prevention as could then be collected. The second (of 1885), besides what may be called the notes of practical treatment given in all the Reports, contains hide returns from Birmingham, and figures and notes of the anatomical structure of the maggot by myself. In 1886 some observations on horse-warble were also given. Losses on hides are especially entered on in returns from hide and cattle firms in 1888; and in 1889 the damage known as “licked beef” is more especially entered on. In the Report for 1890 various good notes were given of loss from “licked beef,” diminished amount of Warble Fly-presence where the cattle had access to water, and other points confirming previous observations; and in 1891, as it appeared unnecessary to go over the information yearly, I only gave a short abstract of the work.*

Through all these years, up to the present date of writing, the work of reply to enquiries had been carried on and (since their issue) the leaflets, giving in short serviceable form the main points of history of attack and well-proved means for its prevention and remedy, distri-

* See Annual Reports on Injurious Insects for years named, price 1s. 6d. each, published by Messrs. Simpkin, Marshall & Co., Stationers' Hall Court, London, E.C. Also (same publishers), 'Warble Fly': Special Reports (from 'Reports on Injurious Insects' for 1884, 1888, and 1889). Royal 8vo, price 3d.; 2s. 6d. per dozen; 16s. per 100. References to U. S. A. Board of Agriculture publications are given, with passages quoted.

buted to all applicants. This has been mostly gratuitously, at my own wish and request, though not entirely so. As 133,000 of the four-page warble leaflet have been distributed, and about 25,000 of the longer leaflet entitled 'Licked Beef,' and as those who were good enough to help our important cause by undertaking distribution of large numbers had all the trouble and postal expenses, I declined wherever I could to receive payment.

In this present abstract, which I have now the honour of laying before my readers, I have endeavoured so to arrange the main points of the information collected in our many years' work as to form a connected account, beginning with egg and egg-laying of the Warble Fly, and working on through its life-history and habits, and structural details of the maggot (by which it lies in our power to destroy it), up to its complete development; then to continue with the sometimes ruinous and constantly injurious effects of the attack to health and produce and return to grower and purchaser of the infested animals, giving under these heads the result of special investigations as to "licked beef," and also special returns regarding losses on hides. To this is added, at considerable length, details of measures of prevention and remedy, and also result of the same in getting rid of the pest, not only locally, but, as in the case of our carefully watched work at Bunbury and Tarporley, Cheshire, over a whole district.

In this I have endeavoured with the greatest care to do justice to the importance of the subject, and it will be seen that I have carefully avoided giving general views and considerations that may or may not be right, but have as far as possible given each observation in the contributor's own words, with the name appended. Very much more could be given from my Reports—because for several years we went over the same ground—especially of means of prevention and remedy, that by the *evidence of so many witnesses*, giving their separate testimony in their own words, the fact which we were working up to of the possibility of certainly and cheaply stamping out warble-attack might be made sure. Those who wish to go over the many repeated details will find them in the Reports referred to at p. 58; but in this pamphlet I have taken those standing on the highest authority, and I think those who will look at the high standing of the names of those leading men and leading firms who have given their help in the different branches of this national investigation, will think we need not fear to go far astray.

One thing I do greatly fear, and that is mischief from erroneous advice of those who, whilst they have neither practical nor scientific knowledge of the attack or its cure, yet unfortunately may, by their attempts to institute unfounded methods of treatment, put back our good work. *I would most earnestly beg all interested to be on their guard.*

What can be done to induce farmers to pay greater attention to warble extirpation is a problem very difficult to solve, but personally I put great confidence in the simple measure of dissemination of *plain* and *true* information. It has only been in the last few years that sound practical knowledge has been attainable for general agricultural use on warble matters, and now it is equally as certain that the information is doing good in many places as it is that the subject is by no means receiving the general attention it deserves.

Whilst these observations were going to press I was favoured, in the course of communication with Mr. W. H. Hill, President of the Sheffield Butchers' Association (and from whom I have received at various times valuable information), with the following remark, which unfortunately describes the state of things only too truly:—

“I have often discussed the matter with farmers, but as a class, whilst admitting the evil, and further admitting it is inexpensive to cure and simple of treatment, yet it is ‘too much trouble,’ or ‘cattle always were so affected,’ or ‘they are too busy with other things’; with the result that, whilst agriculture is, in their opinion, going to the dogs, and the bulk of them, they say, on the verge of bankruptcy, yet they, taking farmers as a whole, are rich enough to throw away several million pounds yearly in the reduced value of their cattle due to this pest.”—W. H. H.

The matter seems to stand something in this way. On the farms this attack, unless in its fully-developed state, and to an unusual extent, is often what may be called a “hidden evil.” From ignorance and idleness and utter carelessness, even when the beasts are sickened with it, the cause is often overlooked. But how this can be met by any outside influence is the difficulty. “Inspection” is sometimes spoken of, but it is not clear how this could be brought to bear on an attack of this sort, where the presence of the warbles may very likely indeed not be observable all at one time, even on one beast, much less on all through a district, but may show gradually, according to date of egg-laying and circumstances of treatment, as in- or out-of-doors feeding of the animal, &c.

The point where it appeals to me (under correction of those who understand the bearings of the case far better than myself) is, with regard to badly-warbled beasts sold for slaughter, whether, so far as direct losses to butchers go from “licked beef,” *i. e.*, state of carcase and coincident bad state of hide, something might not be done by *inspection*. It need not be “governmental.” In this sense most of us, I believe, would quite endorse Mr. Hill's remark now before me, “I am afraid ‘inspectors’ would be a nuisance, for we have too much red tape as it is”; but if the butchers could be spirited up to inspect the animals *thoroughly* themselves before purchase, or to employ a man to

examine them, this would meet *part* of the trouble. If he did not know his work *they* would discharge him; and if he did, his wages would, divided as an outgoing payment from the body of his employers, be a great saving to them.

This would not meet the loss on hide from former injury; it would not meet the losses from coming-on injury; again quoting Mr. Hill's letter to me of the 13th inst. on these points:—"A warbled hide *THIS year* will bear signs, and is damaged by the result of *LAST year*, even when externally nothing could be detected. So, when the maggots are small, or have left their cells, the damage is still there, but by casual inspection not so easily discernible" (W. H. H.). But it would do something.

The great loss from "licked beef" and "jelly" ranges, of course, with the height of the warble-season. After that is over there is not the same need for care (see remarks by Mr. John Child, Manager of the Leeds and District Hide, &c., Co., at pp. 20, 21). Therefore, the expense of examination for this part of the trouble would be only for a portion of the year. Some butchers are well aware of the bearing of the matter, some obviously not; and if all could be got to be on the alert, even about this one part when the attack is obvious to moderate examination, it would do something towards saving loss.

At present we seem to be just in the condition described by Prof. Riley, the late Entomologist of the Department of Agriculture of the U. S. A., when, after the widespread American investigation in 1889, he was requested to take up the question officially. After some observations on the bearing of the subject, in which he greatly noticed our British observations and recommendations, he said he considered there was little to be done, excepting continuing the enquiry on statistical lines similar to those which had been already followed by the investigators; also, that even admitting that some more careful observations might be made on one or two points, that "these are points of biologic interest rather than of economic importance." Therefore, as the case stood, Prof. Riley, speaking officially, stated that, as regarded investigation with a view to fuller statistical information, "we should hardly feel justified in spending time and means therefor"; . . . and he closed his paper with this sentence:—"Being thoroughly familiar with the stock-interests of the country, we know how difficult it is to get farmers to care for their stock, so far as this warble is concerned; and we are satisfied that where self-interest does not dictate better attention we can do little more than point out the means of avoiding injury and the desirability of so doing."*—C. V. R.

* Insect Life. Periodical Bulletin of U. S. Dept. of Agriculture. Vol. ii. No. 6, pp. 176, 177.

This comes very strongly from a man of Prof. Riley's standing, who, besides being unsurpassed for sound knowledge of insect-life, can speak with practical weight as having been a farmer, and for some years manager of 300 head of stock ; but still it seems at least open to hope that with the perfect knowledge of the needs and of the state of the case possessed by our great associations connected with hide and cattle trade in this country, their thoroughly informed considerations, and perhaps united action, might lay a basis which would bring about a much more regulated condition of this great trouble.

ELEANOR A. ORMEROD,

Late Consulting Entomologist of the Royal Agricultural Society.

TORRINGTON HOUSE, ST. ALBANS,
Nov. 20th, 1894.

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