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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS
DURING THE YEAR 1886,
WITH METHODS OF
PREVENTION AND REMEDY.

TENTH REPORT.

BY

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

CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY; HON. AND CORR. MEM.
OF ROYAL AG. AND HORT. SOC., S. AUSTRALIA; CORR. MEM. OF ALBANY INSTITUTE, U.S.A., &c.

LONDON:

SIMPKIN, MARSHALL & CO., STATIONERS' HALL COURT.

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P R E F A C E .

1886 will always be notable agriculturally as the year of the first appearance of the Hessian Fly, *Cecidomyia destructor*, in Great Britain as a destructive corn pest. Where it has come from remains still to be made out, but we see from our own observations of the last few months that there are means of prevention of the multiplication of this pest, easily available in this country, by which we might reasonably expect to keep it in moderate bounds, *if these measures are used*. If they are not, the example of its rapid spread over about two-thirds of European Russia, so that since its first observation in that country in 1879 it has become the most destructive crop-scurge of the land, shows what we have to fear.

The disease known as "Tulip-root" in Oats and also Warble attack to Horses are points which have been little noticed previously; and in the reports now submitted to my readers it will be observed that I have endeavoured as far as possible to limit them to attacks which have either not been previously observed in this country, or have not been as fully reported on as their importance deserved, or, in the case of some of our regular old-standing crop-pests, to information on points of habits and means of prevention not previously contributed.

But whilst the common crop-attacks of "Wireworm," "Turnip Fly," "Daddy Longlegs" grubs, and possibly some others which have already been reported on at length, have been little entered on in this my Tenth Report, there is one subject of national importance, home and colonial, which ought not to be passed over in silence. This is the continued loss in some districts from overwhelming presence of House Sparrows. Further information based on sound observation has continued to come in regarding the injury caused to vegetable, fruit, and corn crops by fostering this most mischievous bird, and in the trouble in prospect of the presence of Hessian Fly, its preponderance is likely to be most

baneful by driving away birds of a truly insectivorous nature. I have not the slightest hesitation in advising every farmer, by every means lawfully in his power, to have every House Sparrow and every nest of eggs of House Sparrow destroyed, and their places of resort for breeding cleared as much as possible.

In the constantly increasing work of my own special department, information is not unfrequently sought regarding foreign and colonial insect-attacks, and likewise it is now necessary to be prepared in this country to meet as best we may the attacks of crop-insects hitherto unnoticed here. Relatively to these points I have been greatly favoured by skilled correspondents,—I may venture to say many friends, in many distant lands,—who have not only helped me by personal communication, but by extensive and valuable gifts of their published writings, thus placing in my hands the best information up to the present time, which in many cases it would have been almost impossible to possess, save through the courtesy of the authors.

In regard to specially-conferred information, I have endeavoured in every case to acknowledge it as called for in the following pages, but the various treatises sent me are of such great service in my work that I desire to mention with sincere thanks the names of some of those to whom I am the most indebted. In Canada I am especially under obligation to Mr. J. Fletcher, Consulting Entomologist of the Department of Agriculture, and to Prof. W. Saunders, Director of the Experimental Farm Stations of the Dominion. In the United States of America I am much indebted to the courtesy of Prof. C. V. Riley, State Entomologist, Department of Agriculture, for the large amount of valuable works of his own authorship, and likewise Government publications forwarded to me; and also to Dr. J. A. Lintner and Prof. S. A. Forbes, the State Entomologists of New York State, and of Illinois; to Dr. Hagen, of Cambridge, Mass.; Prof. Comstock, of Cornell University; Prof. George French Normal, Ill.; Mr. J. Marten, of Decatur, Ill.; and Prof. F. M. Webster, of Purdue University, Indiana; and in California to Mr. Matthew Cooke, late Chief Executive Horticultural Officer of California, and to Prof. E. J. Wickson, for information from the College of Agriculture, University of California. To some of the above friends I am indebted for specimens, as well as for correspondence and for publications of great public service, and to all I tender my hearty thanks.

From South Africa I am in receipt of specimens throwing light in some cases on British crop-attacks; also, for personal and collected notes and observations, to Mr. S. D. Bairstow, of Port Elizabeth, late President of the East Province Naturalists' Society, and to Miss Glanville, lady Curator of the Albany Museum, Grahamstown; and am also indebted to Mr. F. von Schade, of Wynberg, for frequent serviceable communication.

In South Australia I am greatly indebted, as I have been for years, to the skilled co-operation and observations of Mr. Frazer S. Crawford, of Adelaide, Inspector under the Vine, &c., Protection Act, and Government Lecturer on Economic Entomology; and likewise beg to acknowledge with thanks co-operation afforded by Mr. A. Molineux, Member of Royal Ag. and Hort. Soc. of South Australia.

Nearer home I have to express my thanks to Senor Don R. Alvarez Sereix, Director of Statistics and Geography, Madrid, for furthering my work with great courtesy; and likewise to Senor Don Ignacio Bolivar, also of Madrid, for presenting me with copies of his valuable writings, mainly on Orthoptera; and I also acknowledge with many thanks the continued communications of Dr. Friedrich A. W. Thomas, of Ohrdruf, near Gotha, Germany, regarding species and history of *Phytopti*. I am under especial obligations to Dr. J. G. de Man, late Curator of the Museum, Leyden, now of Middleburg; and to Dr. J. Ritzema Bos, Professor of Agriculture at the Agricultural College, Wageningen, Netherlands, for the great assistance most courteously afforded me in researches on the *Anguillulidæ*, and valuable works placed in my hands; and similarly to Dr. K. Lindeman, Professor at the Academie Agricole, Moscow, whose researches on the subject of Hessian Fly are well known, my best thanks are offered for writings and for information.

At home, now as ever, my thanks are due to Prof. J. O. Westwood, Life-President of the Royal Entomological Society, for kind assistance, and likewise to Mr. R. H. Meade, of Manningham, near Bradford, especially for their timely and cordial aid on the occasion of the first appearance of Hessian Fly in this country; and I also beg to acknowledge with thanks the assistance given me in comparison of specimens by Mr. Oliver E. Janson, London, and co-operation, in the important field of Economic Entomology, from Mr. S. L. Mosley, of Huddersfield. Amongst many to whom I am indebted, I do not like to omit the name of my sister

and constant helper, Miss Georgiana E. Ormerod, more especially for serviceable aid in translation of German and Spanish works, which other occupations do not allow me time for.

In the above mention of skilled assistance a portion does not bear on the present Report; but I have thought it a duty not only of courtesy, but to those who do me the honour to apply to me, to mention that for information as to such extra-British crop-attacks as it is requisite I should attend to, I am favoured with means of acquiring the requisite information.

To the Agricultural Press I am greatly indebted for prompt and cordial co-operation, and tender my best thanks.

Many of the illustrations in the present Report have not previously appeared; some are drawn from life by myself, and some of the others are figures from Curtis's 'Farm Insects,' for the use of which, as well as of those from the same work which have previously appeared, I offer my acknowledgments to Messrs. Blackie and Son, Glasgow.

In the coming year any information regarding crop-pests,—and especially regarding Hessian Fly,—will be acceptable, including in this information as to its presence, specimens in any stage, information as to "flax-seeds" being found on imported straw, observations of attack at localities to which imported straw has been conveyed as fodder or bedding, or as litter or long manure.

Specimens are also earnestly requested of Tulip-rooted Oat plants, and of Clover suffering from the disease known as "Clover-sickness."

ELEANOR A. ORMEROD.

DUNSTER LODGE, NEAR ISLEWORTH,

March, 1887.

PS. APPENDIX.—As information regarding both Hessian Fly, and Tulip-root in Oat plants, has continued to come in up to date of going to press, the reader is referred to the Appendix for continuation of these subjects; and I also draw attention to an Erratum, p. 47, 9th line from foot of page; for "wormlets cannot travel," read "wormlets cannot travel as easily as in light soil."
—E. A. O.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1886.

CABBAGE, &c.

Earwigs. *Forficula borealis*, Leach.

The presence of Earwigs to such an unusual amount as to cause serious injury to some field crops and very widespread annoyance has been reported from various localities respectively in Kent, Buckinghamshire, Bedfordshire, and Wilts.

Prof. Westwood has recorded that these insects sometimes appear in immense profusion, notably in the year 1755, when they destroyed fruit and flowers, and "even cabbages"; and the outburst of the last summer appears to have been a very similar case, as, besides damage to various kinds of plants or crops, including amongst them injury to the leafage of an experimental crop of Tobacco, they were especially reported as injurious to plants of the Cabbage tribe, as Thousand-headed Kåle, Kohl Rabi, and Turnips.

As far as I could judge, from specimens sent, the special kind of Earwig present was the *Forficula borealis* of Leach, but very likely the *F. auricularia* was also present.

On Aug. 6th Mr. James Long, of Oldfield, Henlow, Biggleswade, wrote (with specimens accompanying) regarding the damage caused in one of his Turnip and Kohl Rabi fields by the prevalence of Earwigs. He mentions this plague of Earwigs as quite new to him, and one which, whilst it has become of serious and threatening importance, he can in no way account for or alleviate.

"The insects are in great numbers in many parts of the field, and quite destroying many of the plants, especially where the chalk is

near the surface and the land is dryest. . . . The soil has been well treated,—autumn cultivated after wheat, and about 4 cwt. per acre of salt sown on the fallow, beside superphosphate and guano when the seed was drilled. . . . The Earwigs can only be seen by moving the soil around the plants from $\frac{1}{2}$ in. to 3 in. deep.”

On the 13th Mr. Long mentioned:—“I have heard from various quarters that on *chalk* formations—*very generally*—the Earwigs have *greatly* injured the Turnip, Mangold, and Kohl Rabi crops.” Also that on that day when he went to search for specimens he could not find a single Earwig, even under the plants which were almost destroyed by them, nor under any of the others, although at the previous date of writing there were from six to ten under every plant searched. Mr. Long suggests the possibility “that they have penetrated further into the dry chalk, out of the way of the rain and damp mould, than my searching reached to, although I searched much deeper than I previously found them. I can in no way account either for their appearance or their sudden and complete disappearance from *all* the fields.”

On Aug. 10th I was favoured by the following observations from the Hon. Mrs. Cecil Howard as to the prevalence of the same kind of Earwig (*F. borealis*) in the neighbourhood of Great Missenden, Bucks:—

“We are troubled by what I can call by no other name than a plague of Earwigs, and I wish to know whether this has been reported to you, as the whole country round appears to be in the same case. Last week we transplanted some Thousand-headed Kale (planted about six acres), and they did well during the showery weather, and appeared strong. During the last three days these have been completely eaten off, and no fly can be seen, only Earwigs. I do not know if they can have eaten them. The part where the Kale was seeded, and from where it was transplanted, does not appear at present to be attacked.”

On application for any details as to method of manuring or other treatment, which might show some reason for the appearance of the Earwigs, the following information was forwarded:—

“This piece of ground, as it lies nearly on the top of one of our hills, has only been manured by sheep (ewes) being penned on it during the winter and early spring, when the weather permitted; they were only fed on roots and mixed corn chiefly grown on the farm, so that would be unlikely to bring insects. This farm is 300 acres, and the men, who have been for the last month Turnip-hoeing and doing those sort of jobs, report Earwigs everywhere, where they disturb the ground. We first noticed them on the silo-rick we made of Clover seeds and Sanfoin: *none* of that ground had been manured, and when the wires that go over the rick were tightened they came out of the

sides of the rick in hundreds. One night the rick-cloth was put over the rick, and some time after it was put up the cloth was *covered*. Also this last week, carrying Peas from the opposite hill, the waggons were *full* of them. The cottagers complain of them, and they simply swarm everywhere round this country."

On Sept. 5th Mrs. Howard mentioned that they had disappeared from the piece of Thousand-headed Kale, and that it had started growing again; but that they were carried into the rick-yard in great numbers from the adjoining Oat-field.

The extraordinary amount of Earwig-presence was strongly brought forward by the excellently qualified authority, Mr. Martin Sutton, in the following note sent me from Dyson's Wood, Kidmore, near Reading, on Sept. 27th. Mr. Sutton remarked:—"The enclosed cutting from last Saturday's 'Field' exactly describes my own case and those of large numbers of people in our neighbourhood. If possible I think the plague at Dyson's Wood was even worse than that described by the 'Field' correspondent,* and it is only just abating.

"A farmer near here attributes the loss of two sowings of Turnip to the ravages of Earwigs. I do not know how far it is probable they were the cause, but I have had a piece of Mangel Wurzel apparently suffer very greatly from their presence, and roses and flowers of all kinds are riddled through and through with them."

* "A PLAGUE OF EARWIGS.—I occupy a house to which a paddock and large garden is attached; the soil is light, with a subsoil of chalk. Some months ago I was troubled with these disagreeable creatures coming in at the windows and doors, and the only way I could hinder them was by covering all my windows with muslin and closing the doors at sunset. Even then a number managed to wriggle in and cause great annoyance. They dropped on to the supper table, they swarmed in the pantry, getting into fruit pies after cooking, and running out when the pies were cut. They pushed their way into the bread, so that we frequently cut slices off these wretches in cutting bread and butter. They found their way into the beds, linings of hats, coats, &c. When the doors were opened in the morning they dropped in such numbers that the mats were literally covered with them. They hide away in the daytime, so there is not much chance of birds devouring them. One evening I amused myself (by the light of a lantern) in killing them on the walls outside, and I hit upwards of eleven hundred with a hammer in about half an hour, and only ceased because I was tired of the game. I could have killed as many more. I then took the lantern and examined a privet hedge about seventy yards in length; this was then in flower, and I found there were as many Earwigs as flowers. This caused me to give up all hope of exterminating them. I had freely sprinkled the window-sills with insect powder, carbolic acid, and paraffin, with no apparent effect. So tenacious are they of life that, when cut in halves, both parts run about for a considerable time. I have noticed several broods during the summer, so that unless the winter destroys them we shall be eaten out next summer. I have not found the lettuces eaten, but roses are perforated and completely spoiled. Last year they were numerous, but this year I believe there were millions."—'Field,' Sept. 25th.

On suggesting to Mr. Sutton the possibility of silos being centres or starting-points for Earwig attack, he favoured me with the following reasons against this being likely :—

“ I do not think silos have anything to do with the Earwig plague. There is no silo anywhere near here. I imagine the Earwigs were in the grass before it was put in the silo, just as they were in the corn as it was carted to the ricks at my farm. The beds of the carts and the ground underneath at the sides of the ricks were black with them, and a sample of wheat threshed on the field was full of Earwig bodies, dead and alive.”

The above notes refer (as will have been seen) to presence of the Earwigs in common farm crops, as Turnips, Thousand-headed Kale, Kohl Rabi, Mangolds, and also in Wheat: the following note refers also to damage done to Tobacco grown as a field crop.

About the middle of July communication was sent me by Mr. A. Rayfield, by desire of Mr. Faunce de Laune, of Sharsted Court, near Sittingbourne, relatively to attack of Earwigs on his experimental Tobacco plantation. At first it did not seem quite certain whether the injury was caused by Earwigs or caterpillars, and relatively to this point Mr. Rayfield forwarded the following note on July 16th :—

“ I caught a few Earwigs and put them in a bottle, and also some Tobacco leaves on the 14th inst., and find that the Earwigs have eaten some of the leaves; but I believe they have eaten the fleshy part of the stem more than the thin part of the leaf. I notice also that the small leaves of the tops are eaten full of holes in some places, and I have seen Earwigs at night on them, which I believe eat the holes. Earwigs are to be found here this season in swarms, and also in other parishes where I have been.”

Further experiments carried on showed unmistakably that the Earwigs fed on the Tobacco, as the leaves sent, which had been placed with some of the insects in a bottle, were gnawed into good-sized holes. The specimens sent proved to be of the *Forficula borealis*.

It was further mentioned, with regard to the “ tremendous swarms of Earwigs, that not only are they eating the Tobacco, but also Turnips and Thousand-headed Kale, and some of the latter have been destroyed by these insects; and one has only to turn over a piece of earth in some fields, and several Earwigs are turned out.”

In the above observations there is no clue to where this enormous invasion of Earwigs came from.

Earwigs lay their eggs in sheltered places, as in manure-heaps, under clods of earth, &c., and it is stated that the female watches her eggs, and even the young after they are hatched, with great care. In the case of the common Earwig, the *Forficula auricularia*, the female lays her eggs early in the year under stones, in holes in the earth, or

the like places; the young that hatch from these in the spring or early summer are much like their parents in shape, only without wings, and go through their changes like grasshoppers or other insects (which are nearly alike throughout their stages) up to the perfect condition. This perfect insect, in the case of most of the English species of Earwigs, is furnished with a large and beautifully formed pair of wings, elaborately folded under the small, somewhat square-cornered, wing-cases, but, as far as can be gathered, these wings are—with all these kinds but one—not used, or little used, excepting at night.

There are very few species in this country. Of these the *Labidura* or *Forficesila gigantea*, which is about an *inch and a quarter long* and a very doubtful native, is manifestly outside the present considerations. The *Chelidura*, Latr., is so likewise, being wingless, which clearly distinguishes this kind from the perfect specimens received. *Labia minor*, or the lesser Earwig, which is stated by Stephens to be very abundant in the spring throughout the metropolitan district, and to be found flying about especially in the vicinity of dung-heaps, is the only kind stated to fly in the sunshine, and this is distinguished by various points of structure of the feet and horns from samples sent of the pests of the last summer. The kinds under consideration are therefore limited to the true *Forficulæ*, which it is stated “very rarely fly in this country,” and this circumstance, and their objection to exposure to light, appear to be the foundation of all methods for destroying them.

The following note on the subject was sent me by Mr. Ralph Lowe, of Sleaford:—“Small heaps of straw laid at short intervals and fired in a still evening after a few days will destroy immense quantities of Earwigs and beetles. I have seen that plan resorted to rather extensively with marked success in a few exceptionally trying seasons.”

A German method of trapping, which is stated to be extremely successful, is to leave old field weed-baskets, made of split willow, standing for a day or so in one place. In the morning to knock these smartly on a smooth clear piece of ground, when such quantities of Earwigs fall out that it is difficult to stamp on them all before they escape. In this case the expedient of shaking the insects out over a tarred board would make much surer work than merely stamping on the escaping insects.

On Aug. 10th Mr. Rayfield wrote to me as follows, regarding the plans then being tried at Sharsted for destroying the Earwigs then injuring the experimental Tobacco mentioned above:—

“We have several plans of catching these insects, but, although we have destroyed a very large quantity, it does not appear to diminish them. The plan that I have found to answer best is by hanging old bags on gates near the Tobacco or on stakes amongst the plants; old

felt hats also catch a tremendous quantity by placing them on the top of stakes and clearing them out daily."

Possibly where the insects are present in great numbers something to lessen the amount might be done by following up the observation quoted by Prof. Westwood, in proof of some kinds of Earwigs flying at night, "that in a small space of 18 in. square, upon palings fresh coated with pitch on the previous day, no less than fifty or more of these insects had been captured, some of which had still their wings expanded."* Where the insects are ravaging valuable crops in a moderate compass, it might be worth while to try the effect of placing some boards or hanging some narrow long strips of cloth smeared with pitch or wet tar. If successful the expense and trouble would be a lesser evil than loss of the crop.

In garden treatment, and where the dwellers in houses covered with ornamental plants or creepers are troubled with Earwigs, the cure is obvious. If the shelters are removed the Earwigs will commonly be reduced to very small numbers, and (as it is a common habit of Earwigs to lay their eggs under clods of earth, or in holes in the earth, or similar places, and take care of them) all measures of cultivation which would stir the surface well in early spring, and disperse the Earwigs and their eggs, and all measures of tidiness which would clear their various shelters, would be of service.

In regard to the recent field attack, there does not seem any reason for supposing that it was brought on the land in any way, but rather that Earwigs, being unusually plentiful from some reason unknown, they dispersed themselves abroad, and fed on whatever they found suitable for their nourishment.

CLOVER.

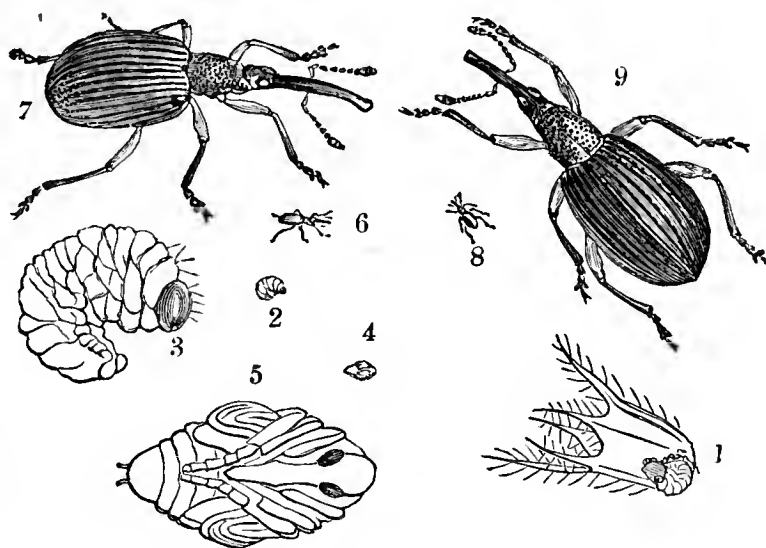
Purple Clover Weevils. *Apion apricans*, Herbst.
(*A. flavifemoratum*, Kirby).

Apions or "Pear-shaped Weevils" are very small beetles with an oval body, to which such a long arched proboscis is prefixed that the whole insect has much the form of a long-stalked pear, whence its name.

There are many species, some of which do great injury to Clover: the two kinds figured are common on the Red or Purple Field Clover, *Trifolium pratense*. To the naked eye both kinds are of a metallic-black, with the lowest joint of the horns, all the thighs, and

* 'Introd. to Classification of Insects,' vol. i., p. 403.

the shanks of the front pair of legs of a yellowish colour, or some shade of brown or reddish. In the *A. apricans* (*subfemoratum*, Kirby) these portions are described by Curtis as lighter or yellower than in



APION APRICANS, *Herbst.*; *A. ASSIMILE*, *Kirby.*

6, 7, *A. apricans*; 2—5, maggot and pupa; 8, 9, *A. assimile* (all nat. size and magnified); 1, maggot feeding, magnified.

the other species, and there are other differences, but these are so slight that at one time the two kinds were considered to be mere varieties.

There is a third kind (the *A. trifolii*), which is very like the above both in shape and colour, which is said to occur sometimes in large numbers on Purple Clover. The *Apion apricans*, more especially known as the Purple Clover Weevil, may be generally described as follows:—Black; proboscis curved and punctured. Horns black, with base of a brownish yellow, and placed at the middle of the proboscis. The thorax or fore body cylindrical, smaller before, and punctured. Head punctured, channelled between the eyes. Wing-cases with deep furrows, the spaces between convex and slightly punctured; the furrow punctured at regular distances. Legs black, with yellowish or reddish thighs, and the fore shanks chiefly of the same colour.

The three kinds, however, above mentioned cannot be distinguished from each other without the help of a good magnifier, and, as far as I am aware, their habits and life-histories are considered to be alike.

After careful examination, especially of the minute leg-joint, scientifically called the *trochanter*, I incline to think that there were very likely both *A. apricans* and *A. trifolii* present in the specimens sent me from Somersetshire.

In the beginning of September heads of Purple Clover infested by "Clover Weevil" were forwarded to me by Mr. Burch from Girleston, West Buckland, Somerset, where the maggots were then doing much harm to seeding Clover. About fifty acres (which were being saved for seed) had then been observed to be

infested by small white maggots, which were feeding at the base of the florets, and it was stated that every field of Clover in that neighbourhood "was similarly attacked." Enquiry was sent whether the maggots would destroy the seed, with the view in such case of cutting the crop for hay instead of leaving the seed to ripen.

At the same date Mr. Broadmead, of Enmore Park, Bridgwater, reported a similar attack on Clover seed in that neighbourhood. "In each head are small white maggots, generally five or six in number. Whole crops have been destroyed, and I have found scarcely a single plant unattacked." The loss is, of course, very great.

On examination I found *Apion* maggots in the Clover-heads sent. These are little fleshy white maggots with brown heads, of the shape figured at fig. 3. The grub lies somewhat curved together and is legless, the front segments enlarged below, and tubercled so as to aid in such amount of progression as it needs to make.

The life-history of the Purple Clover Weevil is as follows:—The beetles live through the winter, and when the Clover has run up to blossom the females lay their eggs in the flowering heads. The maggots which hatch from these eggs make their way through the calyx to the forming seed, on which they feed. They are stated to make their way into the seed, and feed on it until it is consumed; then to make their way out and to turn to chrysalids amongst the drying flowers. In the specimens sent me I found some of the little maggots free in the heads. From these chrysalids the weevils come out in about a fortnight, or, in the case of autumn broods, *may remain in chrysalis-state till spring*. This point may be important for practical purposes, as also that mentioned by John Curtis of the weevils being soft and tender when first developed from the chrysalis-state, which I had an opportunity of observing in the specimens sent. As the stages of their life-history are gone through rapidly there may be several generations in one year; the pests stored as maggots or chrysalids with the first harvested Clover will produce swarms of weevils to come out and attack the blossoms of the second crop, and so continue their generations, weather and crop permitting.

Besides the loss caused by the weevil-maggots destroying the seed in the head, the weevils themselves do harm by feeding on leaves of the growing Clover.

With regard to possibility of applying any remedy to attack when present in the flowering heads, it does not appear that when the flowers present the rusty or prematurely withered appearance, which shows that the maggots are feeding on the forming seed, that any measures to save it can be of the slightest service. The crop need not be totally lost, for it can be mown under common circumstances for hay.

The only thing which it seems possible to do is to lessen the amount of weevil-presence in the neighbourhood beforehand, and, as the points of this treatment have been so well given many years ago by M. Herpin that it is hardly possible to state them more clearly, I quote them from the translation in Curtis's 'Farm Insects' :—

“ 1st. Cut early, and feed off (while green) the Clover crops which are known, or supposed to be, much infested by the *Apion*.

“ 2nd. Carefully avoid allowing the Clover crops to remain more than two years in succession on the same ground.

“ 3rd. Avoid also allowing the Clover which is much infested by the weevil to ripen and run to seed.

“ 4th. Alternate and vary the culture.”

The 5th suggestion is that, if the Clover is stacked green, and subjected to a sufficiently high fermentation to turn it brown, that the maggots contained in it will be destroyed. At the present day the use of the silo would assist in this case.

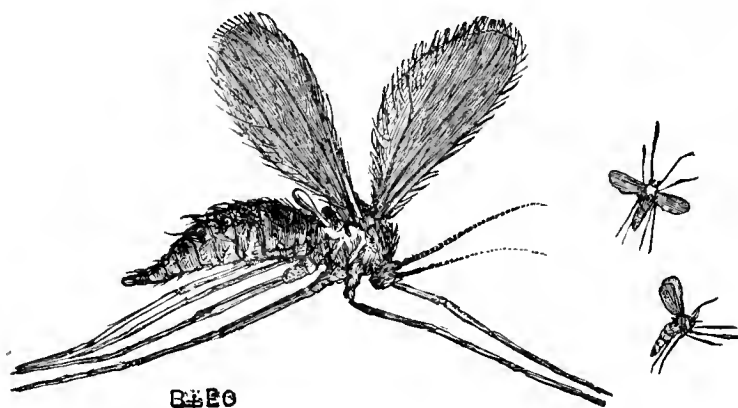
Where infested Clover is stacked in the common manner great numbers of weevils escape from it, and very probably something might be done to kill these by throwing quicklime or gas-lime on them. When they are in such numbers (as has been recorded) that there are scores on one plant, and they are regularly sweeping on from the stack from which they started, something might be done to get rid of these hordes. When properly developed the Purple Clover Weevil has a powerful pair of wings, but in those which I examined, which developed in captivity in a closed box filled with Clover-heads, so that there were no favourable circumstances for expansion, most of the wings were abortive, or not properly formed. Where this is brought about in farm practice by the above mentioned methods of stacking or otherwise, it would be a great check on spread of the pest.

The habits of the two kinds of Red Clover weevils are considered to be similar.

The measures suggested by Mr. Whitehead of feeding off infested plants in autumn by folding sheep on the leys, and likewise of burning refuse Clover-heads after threshing, could not fail to be of service.

CORN.

Hessian Fly; American Wheat Midge. *Cecidomyia destructor*, Say.



CECIDOMYIA DESTRUCTOR, *Say*.

Hessian Fly, natural size and magnified.*

As far as at present appears there has been no recorded presence of the Hessian Fly in Britain until the latter end of July of the present year (1886).

Those who desire to trace its history from its first outburst as a destructive scourge in North America during the years 1786 to 1789, with full reports of its history, habits, gradual spread, destructive powers, and ravages, up to complete attacks of crops, onwards to the date of its first proved appearance in Europe, and the testimony borne (up to July of the present year) of the absence of this pest from our own country, will find information on these subjects in the works whose titles are quoted in the appended table.

Relatively to the watch instituted on its very first appearance in America lest this pest should be transmitted to our own land, we find that in 1788 the wheat crop was so much injured in various North American localities, from which corn was then exported in large quantities to Great Britain, that the exportation of grain from America was prohibited until the English Government was assured that the fly with eggs could not be introduced in the grain;† and next, that consequently on the annually recurring tidings of the more and more widely extending devastations of the Hessian Fly in America, the investigations on this side the Atlantic were set on foot by Sir Joseph Banks, the result of which was, as reported by him, “that no such insect could be found by him to exist in Germany or any other part of Europe.”‡

* The following paper is a reprint of my pamphlet, ‘The Hessian Fly in Britain,’ giving an account of the main points of the observations up to the date of going to press. Further information will be given, if desirable, in an appendix.

† Bulletin No. 4 of U. S. Entomological Commission.

‡ Dr. B. Wagner on Hessian Fly. Report of U. S. Entomological Commission, 1880 - 82; Appendix I., p. 28.

An alarm took place as to the arrival of the pest about the beginning of the present century, which was proved to be unfounded by evidence that it was another kind of fly.* The well-known passages in Kirby and Spence's 'Entomology' as to the destructive character of this pest *if* it gained footing give a long range onwards of *non-observation* from about 1815 to the date of the edition of 1855; and in 1845 John Curtis notices the attack as one which, as it had *then* been detected in Europe, it was well to mention. And, in the summary of information given in the 'Report on Hessian Fly,' brought out by the United States Entomological Commission, 1880-82, I find these statements: "We know that the *Cecidomyia destructor* does not inhabit England or Scandinavia."†

Throughout this course of years we do not find any authentic notice of the Hessian Fly occurring on our side the Atlantic until possibly 1833 in Hungary, but the first sure statement of the existence of the Hessian Fly in Europe is considered to be that of "its discovery, by Mr. J. Dana in 1834, at Mahon, Toulon, and Naples" ("Hessian Fly not imported from Europe," 'Canadian Entomologist,' 1880).

It is now known to exist in the South of France, Austria, Hungary, and during the last seven years its presence has been reported in Southern Russia, and its original habitat is considered most probably to have been Southern Europe and Western Asia, *i. e.*, about the shores of the Mediterranean Sea. (Report of U. S. A. Commission, previously cited).

The past summer has shown its presence amongst ourselves. On July 27th the first specimens of the peculiar flax-seed-like pupa were forwarded to me by Mr. G. E. Palmer from his barley fields near Hertford, and shortly after the attack was reported as found on other neighbouring farms. On Aug. 10th some small amount was found at Stubbers, near Romford, Essex, in wheat; on Aug. 28th the same attack, with pupæ now advanced to the striated condition (that is,

* See Linn. Trans., ii., 76 - 80.

† The name of Hessian Fly was originally given in consequence of the fly being noticed about the same time with the arrival of the Hessian troops in America. Those who wish to see the evidence by which this transmission is thoroughly disproved will find the subject entered on at length in a paper by Dr. Hagen, entitled, "The Hessian Fly not imported from Europe," 'Canadian Entomologist,' October, 1880. The dates, with names of ports of embarkation and those of arrival in America, are there given both of the Hessian and German troops; and (to give just one note of the various movements specified) it will appear plain that where troops left Hesse in February, Spithead in May, and arrived in Sandy Hook in July, or up to August 12th, that the "flax-seeds" could not by possibility be thus conveyed. If pupæ had been in the straw (if straw was conveyed) they would have developed long before the middle of summer, if they were in a state to develop at all. Full details will be found in the paper referred to.

with lines running lengthwise along them), was found at Ware; and on Sept. 1st and 2nd respectively similar attack was reported (with specimens accompanying) from barley near Inverness, and also from barley near Crieff, Perthshire. In all cases the nature of the attack was identified by sample specimens forwarded to me. Reports were also sent me of similarly injured straw being observed in various parts of Scotland, and that "the insect had been observed in various counties widely apart."

On Sept. 22nd Mr. G. E. Palmer reported that the pupæ of the Hessian Fly had been found at three farms near Hertford, two farms near Hitchin, one near Ware, and one near Luton, Bedfordshire. These localities include Mr. Palmer's farm and that at Ware previously mentioned. The observations were taken by Mr. Palmer and Mr. H. Dorrington, residents near Hertford, perfectly qualified to identify the attack.

Amount of injury caused by Hessian Fly attack.

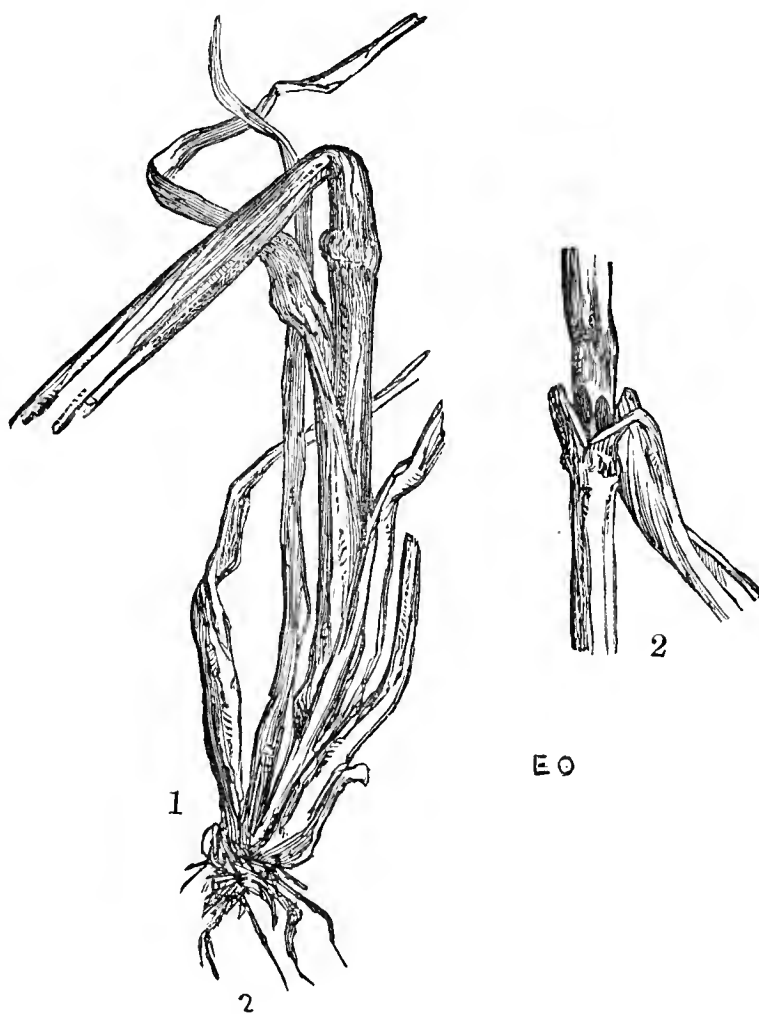
It is unnecessary here to enter on the losses liable to be caused by this attack, of which details will be found in the works referred to in table appended. They may be shortly stated as any amount from slight attack up to devastation of whole large districts. Some of the communications regarding amount of attack this year in this country mention "the barley being very much injnred" (this on fields respectively of 33 and 15 acres); "considerable damage"; being "struck with the number of broken-down stalks"; and one estimate is of a "loss of several bushels per acre" (this from one English and three Scottish localities); and a general report sent to myself mentioned the attack in Scotland as having "been observed in various counties widely apart, and causing considerable havoc to crops and anxiety to farmers." Just as an example of amount of loss in the United States, in one State, at dates widely apart, it may be mentioned:— In New York State the loss last year through this attack was estimated at 100,000 dols.; in 1846 the insect was destructive through the whole State, and the loss in the western section was estimated at 500,000 bushels. Details of losses in various years and localities in U. S. A. from 1776 will be found in the Report of the U. S. A. Ent. Commission, previously quoted.

Appearance of attacked Crops.

In Mr. Palmer's notes of the appearance of his infested fields, he mentioned that at first he thought that the barley was "simply root-fallen," but on closely examining the stems he found that most of them had given way just above the second joint from the root, and

then found that the maggot, of which the chrysalis was sent, was the cause of the attack; and in the report of the attack from near Perth there is similar mention of the broken-down stalks and small brown pupæ found at the injured part.

On examination in the fields near Hertford, on the 30th of July, I found the stems doubled sharply down a little above the joint, as shown in fig. 1, No. 1, and between this double and the joint below there lay, closely pressed to the stem and covered by the sheathing-leaf, the flax-seed-like chrysalis-cases, figured on the right hand of the bent stem. The injury is caused by the fly-maggots lying at the same spot sucking the juices from the stem, which is thus weakened, and

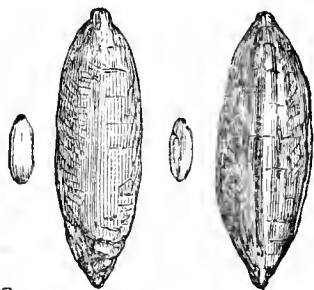


No. 1.—Attacked Barley-stem; 1, bent down; 2, showing “flax-seeds.”

presently, although both the stem and the ear above are more or less stunted, yet the weakened piece of stem cannot bear their weight, and it bends sharply down at the injured part. Sometimes a gall or some amount of swelling of the stem occurs just above where the maggot fed, but in the specimens I examined this was rarely noticeable. I am told by Mr. John Marten, of Albion, Illinois, U. S. A., an economic entomologist who has especially made a study of this attack, that the specimens I showed him corresponded in absence of gall with the condition of those in Illinois.

“Flax-seeds,” Chrysalis-cases, or Puparia.

These were from one up to sometimes three or four in number, usually only one or two; they were invariably set upright (not lengthwise across the stem), and sometimes, but not always, were fixed at the lower end by being a little embedded in the straw. The “flax-seeds” were for the most part the sixth of an inch long, of a spindle or long oval shape, somewhat slightly flattened on one side, and more so on the other; the two extremities bluntly pointed, one conical, the other, which is the anterior end, usually slightly bent forward with a pinch across the “flax-seed” near the end, as if the flattened side had been bent in almost against the other side by a nail. The colour was



E O

No.2.—“Flax-seeds” or Puparia, in different stages of development, nat. size and mag.

at first of various shades of chestnut, from quite light to full brown, and both in colour and in shape the cases had a strong resemblance to the flax-seeds from which they take their name, except in being narrower. This brown case is the hardened skin of the maggot, and in this *puparium*, or pupa-case, the maggot changes first to the *pupa* and thence to the perfect fly; at the earliest part of the observation the transverse lines showing the divisions of the segments of the maggot were still noticeable, but gradually, as the skin hardened, it contracted lengthwise, and the transverse lines wholly or almost entirely disappeared, and instead of these the flax-seed was marked with parallel lines. The first specimen in which I noticed these running along it from one end to the other was sent me from Ware on the 28th of August. The figure is taken from two of my own specimens in different stages of development at the beginning of October.

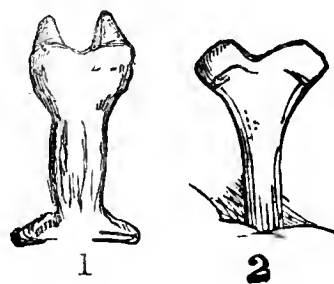
Contents of the “Flax-seed,” Chrysalis-case, or Puparium.

As the attack had passed into the flax-seed state before it was reported, I had no opportunity of observing the maggot whilst it was still active and in feeding condition; therefore, in order to keep the British observations clearly distinct from those of other countries, the description and figure of the maggot taken from Dr. Packard’s paper on the Hessian Fly is appended in a note.* I had, however, the opportunity, by careful dissection of a newly-formed “flax-seed,” of making out some of the points of the structure of the larva. On opening the brown case I found the legless maggot within still unchanged as to development; it was bluntly oval, with the head

* “The egg is very minute, about the fiftieth of an inch long, cylindrical, pointed at each end, the shell shining and transparent, the egg being of a pale red colour when the embryo is nearly developed.

retracted, and it was of a white milky colour, excepting at the divisions of the segments, and also along the central line from one extremity to the other, which were all of a greyer tint. This appearance is stated by Dr. Wagner to be the beginning of the development of the adipose body, which "is distinguishable as snow-white masses from the remainder of the more transparent body."* Beneath the maggot, close to the head-end, was the chitinous appendage, which is known in America as the "breast-bone" of Cecidomyioides larvæ, with us the "anchor-process."

As I am not aware that this anchor-process of the larva of the *Cecidomyia destructor* has as yet been precisely figured, I give a magnified sketch from my own British specimens. The anchor-process is a short stem fixed at one end to the larva, and free at the other; the free end, which points forward, is considerably enlarged, and is of various form. In the "red maggot" of our own British Wheat Midge it is notched, as at fig. 2, No. 4, but in the anchor-process of the Hessian Fly the shape is more elaborate. The stem is slightly enlarged at the middle, and the extremity furnished with two conical prolongations, forming together a strong fork. When seen sideways the process looks more slender, and has a curved figure making a gentle arch from the insertion to the forked tip.

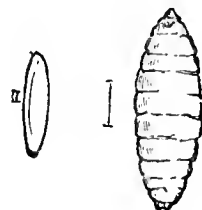


No. 4.—1, anchor-process of larva of *C. destructor*; 2, of *C. tritici* (magnified).

The use of this appendage does not appear as yet to be fully known, but from my own observations I conjecture that it is used as a digger or scraper, and it may be that the reason why strong-stemmed wheat, or stems containing more silica, are not so much injured by attack as other kinds, is, that the fork is not strong enough in these instances to assist the excessively delicate mouth-parts to acquire their food from the stem.

The formation of the skin of the maggot is very peculiar, and, as

"*The larva.*—After remaining about four days in the egg-state the larva or maggot of the Hessian Fly hatches, and is of the form represented. The body is soft, smooth, shining, oval, cylindrical, beneath a little flattened, and consists of twelve segments besides the head, the latter soft, fleshy, and but little separated from the body, with very rudimentary mouth-parts."—Hessian Fly Report of Department of Agriculture, 1880 - 82, p. 208, previously cited.



R + P
No. 3.—Egg and maggot of Hessian Fly, nat. size and mag.

The above figures of egg and larva are copied from the same. The larva, when fairly advanced in growth, is stated by Dr. Wagner to be white or yellowish white, transparent at the sides.

* Dr. Wagner on the Hessian Fly, Appendix I. Third Report of United States Entomological Commission, 1880.

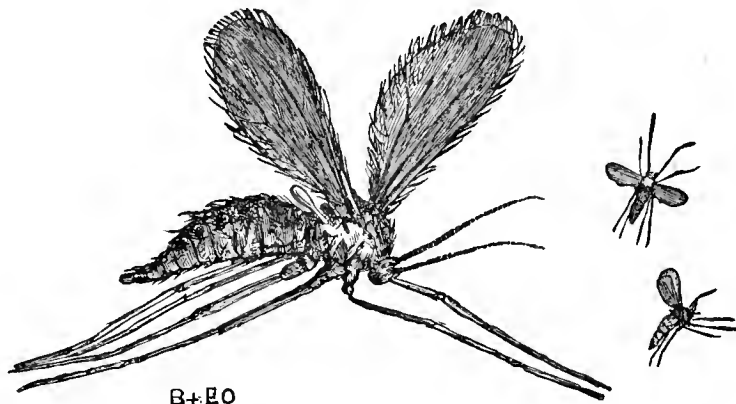
seen under a $\frac{1}{4}$ -inch power, resembles nothing so much as a nutmeg-grater. It is covered with most minute tubercles, each about the height of its own width, and each with a depression or orifice in centre. The two figs. at No. 5 give a view sideways and from above of these tubercles from the dried skin of a larva, with the anchor-process attached, taken from the puparium.



E O

No. 5.—Skin of larva, magnified.

About the beginning of October, on again examining the contents of a "flax-seed," I found the larva or maggot within considerably altered. It did not as yet, as far as I saw, show any development of limbs, but it was now changed to a reddish yellow colour, of a brighter red along the back. As these changes of tint are stated by Dr. Wagner to follow almost immediately on the rudiments of the coming wings being observable, it is probable that examination with a better light, or with a stronger microscope-power, would have shown their appearance.



B+EO

No. 6.—*CECIDOMYIA DESTRUCTOR*, Say. Hessian Fly, nat. size and magnified.*

The Imago or perfect Fly.

On the 8th of September the first fly developed from my "flax-seeds" or puparia. This to the naked eye was a stout-made little brown gnat, with darker head and body, legs of rather lighter brown, brown horns, and a pair of smoky-grey wings with longitudinal veins. It was exactly one-eighth of an inch in length.

In order to note the successive changes in colour occurring up to maturity and immediately after death, I observed the specimen at intervals for about three days, and endeavour to give the result as plainly as I can. The fly was first noticed about four in the afternoon amongst my specimens of infested straw, and I secured it by passing a long fine rod of twisted paper just moistened at the tip with chloroform beneath it; this stupefied but did not quite kill it, so that I could observe it with very slight disturbance from movements of the insect.

* The position of the imago is after the fig. *f.* by Mr. Burgess in plate iv. of paper on Hessian Fly in Third Report of U. S. A. Ent. Comm. already quoted; the details, &c., from my own British specimen.

About three hours after being first noticed the abdomen, as seen with a 1-inch power, was of various tints of a yellow-brown colour.* The following morning, on investigation of details, the thorax was black above, yellow or pale yellowish brown beneath the root of the wing, and with another patch of the same colour in front,—that is to say, a patch about half-way down on each side of the prothorax. The six segments of the abdomen nearest the thorax of a raspberry colour, paler below, with a broad black transverse band extending over the back and half-way down the side of each segment, which was also marked with a well-defined black velvety patch on each side. The terminal segments of the abdomen and the extended ovipositor were of nearly the same shade of yellow, or pale yellowish brown, as the patches on the side of the fore body, and the ovipositor was *not* furnished with lamellulæ at the extremity. The 7th and part of the 8th segments were marked above with a small V-shaped figure with a fine line on each side, parallel to the sides of the V, the lowest end of the V pointing backwards. The figure was only noticeable when the abdomen was seen from above, and was not of deep tint.

The halteres or poisers were of a bluntly-pointed club-shape at the extremity, and yellow with a sprinkling of hairs, which in some lights gave a blackish tint to the upper part and also to the base of the club, and at this stage there was a marking of raspberry-red just about the middle of the poisers. The body and abdomen were in parts very hairy, and the black velvety patches on the sides of the abdomen appeared to be composed of stout, black, bristle-like hairs. The two wings smoky-grey, fringed at the edges with long fine hairs, and sprinkled over the surface with hairs, and also with ribbed scales, resembling one of the forms found on butterflies' wings. The wing-veins all ran lengthwise, the first almost close to the front margin of the wing, running parallel to it, and uniting with it about half-way down; the second running straight along the wing at rather less than one-third of the whole width of the wing from the front, until near its termination at the tip of the wing it curved slightly backwards; the third vein (placed about the width above mentioned from the hinder margin) runs almost straight, ending at the hinder margin about one-quarter of the length of the wing from its tip; this third vein throws out a side-branch, which curves backwards to the hinder margin of the wing exactly opposite the termination of the first vein. Legs very long and fine, yellowish brown, hairy; uppermost joint of tarsi very short. Eyes black; antennæ beaded, long, and hairy. The two basal joints shorter and wider than the succeeding beads. The

* For fuller descriptions than I can give from my own observations of the early changes of colour the reader is referred to Dr. Wagner's paper, previously referred to.

remainder of these up to the apical joint (with the exception of those immediately succeeding the basal joints)* were rather longer than wide, apparently cylindrical in form, and slightly contracted at the middle; the terminal joint was bluntly pointed and about as long again as the preceding bead. These joints were at first distinctly stalked, so that, excepting towards the end of the antenna, they could be seen to be distinctly separated. From the minuteness of the division, and also as with maturity and death, the beads drew so nearly together as almost to appear to touch, I had great difficulty in counting them, but after repeated examination they appeared to me to be nineteen in number, that is, 2 plus 17. The colour altered with change of condition of the specimen, but might throughout be called brown.



No.7. Wing
of Hessian
Fly, mag.

The above account refers to the condition of the specimen whilst still not quite dead, about eighteen hours after the first observation. Twenty-four hours later the raspberry tints were changing to shades of brown or yellowish brown, and the black velvety patches at the sides of the abdomen were scarcely distinguishable from the transverse bands. The changes in colour continued, till on the third day from the first observation the raspberry tints had changed to dark brown above, lighter or yellowish brown below; the terminal segments and the ovipositor still retaining the original tint of yellowish brown.

From minute examination of structure and comparison with the descriptions and figures in the works cited, the imago appeared to me to be without doubt the *Cecidomyia destructor* of Say, commonly known as the "Hessian Fly."

In an attack of this importance, regarding which it is yet to be seen whether it will settle in the land as a national scourge, or be a temporary infliction from causes not yet made out, I in no way desired to rest solely on my own opinion. I therefore submitted infested straw to Professor Westwood, Life-President of the Royal Entomological Society, who is personally acquainted with the insect in the "flax-seed" as well as in the perfect state, and also forwarded others to Prof. W. Saunders, President of the Entomological Society of Ontario, Canada, a well-known and most sound authority in the matter, and received from both the above referees the confirmation that the specimens sent were without doubt the pupæ of the true Hessian Fly. On the appearance of the imago I submitted it for special examination to Mr. R. H. Meade, of Manningham, Bradford,

* I unfortunately omitted to make a note of the precise form of these at the time; from memory I should say they were like the corresponding joints of the male antennæ, as figured by Dr. Packard, but not having figured and noted them at the time the observation may not be correct.

whose researches on the Diptera are too well known to require any comment, and had from him the benefit of definite opinion that it was *Cecidomyia destructor*, Say. Further, I have had the opportunity of submitting the whole series of specimens to Mr. John Marten, of Albion, Illinois, U.S.A., one of the economic entomologists of Illinois, known by his papers on injurious insects, published in Reports of the Department of Agriculture, U.S.A., and whose opinion is of much value, as having made a special study of the Hessian Fly.

Abstract of Life-history.

The following extract from a German source* gives the main points of the life-history of the fly in Europe in short and plain form :—

“*Cecidomyia destructor*, Say.—The larvæ live in the haulm of wheat, rye, and barley. The female flies usually lay their eggs on the young leaves twice in the year,—in May and September,—out of which eggs the maggots hatch in fourteen days. These work themselves in between the leaf-sheath and the stem, and fix themselves near the three lowest joints, often near the root, and suck the juices of the stem, so that later on the ear, which only produces small or few grains, falls down at a sharp angle. Six or eight maggots may be found together, which turn to pupæ in spring or about the end of July, from which the flies develop in ten days.”—Stett. Ent. Zeit., xxi., p. 320.

Where does Hessian Fly come from ?

The question now arises, Where does the attack of Hessian Fly come from? It does not appear to have risen up gradually in the country, as we find it widely spread,—that is, in various parts of Scotland, as well as in one district of England,—without any observation of its previous presence having been reported from any quarter, although the attack is of a kind which is very observable, and attention is given to insect injuries to the crops more or less in every part of the island. It may come in the “flax-seed” state in straw imported from any of the countries troubled by this pest; it may be received from Canada, or from the United States, or from the South of Europe, Austria, Hungary, or Russia.

In respect to its importation in straw, it may come in straw-cargoes, or in straw used as packing material. Where this straw is sent forward to farms as it is, or as slightly-used litter, or as “long” manure, quite a sufficiently large proportion of the flies in the flax-seeds are likely to develop to cause mischief such as we have seen in

* See Die Pflanzen feinde, von J. H. Kaltenbach. Stuttgart.

the past season. On the first farm on which the attack was observed near Hertford, I found on enquiry that London manure had been used of mixed kind, but mainly cow and horse manure in "very long" condition.

Another way in which it is at least possible that the "flax-seeds" may be transmitted is in wheat or barley from infested countries. This method of transmission is stated not to be at all likely, because the sheathing-leaf enfolds the wheat or barley stem so tightly just above the joint where the pupæ lie that it is considered they would not fall out in the process of threshing. But on investigation of the attacked straw, both in the field and after being stored away, I found it very liable to break at the bend, and thus expose the contained "flax-seeds"; and on October 22nd I received information from Mr. Palmer, of Revell's Hall, that after threshing some of his infested barley he examined the small seeds and dust sifted out of the threshed corn which fell beneath the machine, and in this he found "flax-seeds" to the amount of fifteen in a handful of siftings. Specimens of these were forwarded to me.*

No pupæ were found in chaff or grain. This matter will be further investigated by observations from other farms, and all information is solicited on the point, as it is of enormous importance.

In cleaning seeds of the fox-tail grass from those infested by *Cecidomyia* of another species, it is found the infested seed, being lightest, falls at a separate spot; and, if we find that the Hessian Fly puparia fall just below the machine customarily, there will be neither difficulty nor loss in collecting the rubbish and dirt and destroying it.

From the above observation it appears that puparia or "flax-seeds" may be transmitted in corn rubbish. In samples of screenings and "sweepings" from imported corn I have found, besides a large amount of live and dead beetles, also weed-seeds, ergot, and other matters undesirable to spread abroad (as may easily be done where these are used for poultry-food, and thus thrown out in farmyards), and as, with these, broken bits of stem are to be found, it appears at least possible that "flax-seed" may also be conveyed. In Dr. Packard's paper on the subject (previously quoted) he alludes to the possibility of the pest being transmitted in wheat.

Methods of Prevention.

At present nearly all we know on this head is learnt from agricultural publications of other countries, and especially from the Reports of the Agricultural Department of the United States, but in our own country we have one regular and constant safeguard against

* The observation has since been further confirmed.—E. A. O.

autumn attack in the fact that wheat in this country is not sown usually until well after the time when plants may be considered safe from eggs being laid upon them by the autumn brood of the Hessian Fly.

This point of prevention is stated as follows in the Third Report of the United States Entomological Commission: "*Late sowing of most of the wheat seed.* All writers, both entomological and agricultural, concur in recommending this easily applied remedy, that at least a part of the wheat should not be sown until after the 20th September in the Northern States."*

In this country this remedy is applied for the most part in regular process of farming arrangements; commonly our wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

The Hessian Fly has commonly two broods in the course of the year. The flies which come out in August or September from the "flax-seed" chrysalis-cases, sheltered above the second joint of the straw from the ground (such as we have this year been troubled with in England and Scotland), lay their eggs, we are informed by various observers, Professor Riley, State Entomologist, U. S. A., amongst the number, in the grooves on the surface of the leaves, or between the stalk and sheath where loose, and, as soon as the footless larva or maggot hatches, it makes its way down the leaf to the base of the sheath, which in the young winter wheat is at the crown of the root. Here it is stated to fasten itself lengthwise to the tender stalk, and to move no more, but remain fixed at one spot sucking the juices until it becomes embedded at one extremity in the outer part of the stalk, and in five or six weeks, according to the season, to turn to the flax-seed chrysalis. In the case of attack to the young wheat, the maggots drawing away the juices just near the ground-level, cause it to turn yellow and die.

The flies from these "flax-seeds" come out in spring, or about the beginning of May, and, as where the corn is running up to stem the tender ground leaves are no longer to be found, which are used for autumn egg-laying, the flies have no choice, but they lay them instead, as we know, so that the maggot when hatched shelters itself between the stem and sheath just above the first or second joint from the ground, and there it turns to the flax-seed chrysalis, from which the autumn brood presently come out.

To return to autumn means of prevention, as previously said, if there is no accommodation ready for the autumn brood, a great deal of it necessarily perishes without egg-laying, but further (in case quite

* See Third Report of United States Entomological Commission, Department of Agriculture, p. 221, 1880 - 82.

early-sown wheat is found to be infested), by *ploughing this in* the maggots and eggs will be killed; and, in the words of Dr. Packard, this brood may be circumvented or destroyed so that a spring brood cannot appear from it.

A less expensive method of attracting the flies is the use of what is called "bait," that is, sowing some narrow strips of wheat to attract the flies, *and ploughing this in with the eggs and maggots*; but for ourselves the plan arranged by Mr. G. Palmer on his farm of Revell's Hall, near Hertford, appears best of all as costing little or nothing, and meeting all purposes.

Mr. Palmer showed me that on his worst infested barley field, which was bare at the root, he had allowed all the self-sown barley to sprout; thus it was ready for attack of all the flies which were hatching, or might be hatching, out of the "flax-seeds."* When the time was passed the plant was to be fed off by sheep, which would eat the leaves with eggs on them, and any maggots which had effected a lodgment in the centre of a plant too far down to be bitten out would be effectually killed by the subsequent ploughing coming in regular course of operations.

The above refers to where stubbles are left; where they have been cut high so as to leave the infested part standing on the field it is probably the best plan at once to skim and collect the stubble and burn it, but from the practical difficulties in the way of carrying out this high cutting, and the amount of loss entailed, it does not seem likely to be carried out.

Deep ploughing directly after cutting of stubbles which have been infested would turn any "flax-seeds" which had been shaken out well under, so that the flies from them, even if they did hatch out, could not make their way to the top. Where there is clover or seeds it does not seem possible to do anything relatively to attack that may very likely recur on the self-sown corn, excepting what may be done to kill the young maggots or "flax-seeds" by dressings; for this purpose the use of lime, salt, or soot have been recommended.

In regard to infested straw taken off the field, I am informed by Mr. John Marten (quoted previously) that it is found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow; thus a very great proportion of the flies which come out of the "flax-seeds" are

* Nov. 1st, 1886. During the last few days specimens have been sent from these plants, and shoots from old plants infested with Hessian Fly puparia in various stages, from white condition just passing from larval state up to regular "flax-seed." This shows that the *puparia* found in the corn-stems in August, or a portion of them, do hatch out their flies in this country, and *confirms the need of every precaution.*—E. A. O.

destroyed, simply because they are not able to get to the outside of the stack.

It is difficult to see how, except on a broad scale, by arrangement like the above we can manage to meet the difficulty of attack spreading from infested straw. In any common way in which it is used it is open to letting the fly escape from it, and it is impossible without very severe loss to destroy it. The method of saving the straw which places the greater amount of it in a condition in which it cannot spread attack, whilst being stored for gradual use, seems worth consideration.

With regard to chaff and rubbish from the threshing, we do not as yet know what amount of "flax-seed" is to be found in them, and we need report from competent inspection, so that we may know with certainty what amount of "flax-seeds" are to be found in them. It will be eminently desirable that infested chaff should be mixed with wet manure, or destroyed as may be most convenient as rapidly as possible.

One of the most important remedies or means of prevention of damage is hearty growth, which will carry the young plant through moderate attack, or, if part perishes, will carry the other shoots on; and another is the choice of hard-stemmed wheat.

The evidence now coming in points to the possibility of the "flax-seeds" being loosened, and more observations will shortly be sent in; but meanwhile (see p. 20) it is of the utmost importance, in threshing infested crops, that the siftings taken from immediately below the machine should be burnt.

Dressings, &c.

Lime, soot, salt, and "plaster" are mentioned as being serviceable as dustings on young plants infested by maggots. By plaster I am informed burnt gypsum or plaster of Paris is intended. There appear to be various opinions as to real benefit from these applications, and also whether they can, even when melted by rain, reach the maggot sufficiently to destroy it; but, in case of any dressing being useful, it seems likely that the mixture found serviceable many years ago by Mr. Fisher Hobbs might answer still better, as in this the gas-lime would take the place of the gypsum or plaster. The mixture consists of quicklime and gas-lime, each one bushel; soot, ten pounds; sulphur, six pounds; the whole to be well powdered and mixed and applied when the dew is on. The above amount was sufficient for dressing two acres of Turnips as a preventive for fly, and the quantity could be increased at discretion. This application would in any case be useful by promoting good growth, which is a point very much dwelt on as a preventive of overwhelming damage from attack; in illustration

of this point a note is given in Dr. Packard's paper, previously quoted, regarding attack to a field of young wheat. In the hollows on deep soil "the wheat was very large, and kept green and growing; while on the sharp points of knolls and hard clay ridges it was nearly gone. On a piece of new land near by, where never a kernel of grain was grown before, no fly or injury could be seen." The first part of the above observation agrees very much with what I saw on the attacked land at Revell's Hall. One large field of about thirty acres at the top of the hill, and another adjoining, which were on dry shingly soil and greatly exposed, were much the worst attacked; whilst another in the hollow, which was cooler and better land altogether, had not suffered nearly so much. Should we have the misfortune of this attack settling down amongst us it will be worth observation to find whether the fly comes worst to the crops sown alone or with clover or seeds. In the fields above mentioned the worst attacked were barley alone; the least attacked had clover and seeds.

Rotation of crop, which excludes wheat, barley or rye on attacked land, is exceedingly important; the Hessian Fly only attacks some of the cereals, therefore all leguminous and root-crops are perfectly safe, and likewise, as they cannot be used as food, help greatly in lessening the prevalence of the pest.

The choice of kinds of corn with hard stems, such as cannot be easily injured by the suction of the maggot, is also particularly dwelt on and kinds named, but as these differ from our English kinds it is unnecessary to give the list. A summary of the above might be shortly stated thus, beginning at harvest-time* :--

If possible reap so as to leave the "flax-seeds" in the stubble, and destroy this infested stubble; otherwise treat the harvested straw so as to destroy them.

If flies are likely to be about let the self-sown corn on fields that were infested sprout, and presently turn sheep on to feed off the infested plants, and then plough the remains in. Ploughing in infested stubble is also useful. "Bait" may also be had recourse to by sowing strips or patches of corn to attract the fly, and treating them as above.

Late sowing, so that the young wheat will not be up until the

* In American treatment the great importance of preserving the insect parasites, which feed on the Hessian Fly in its early stages, is most urgently insisted on, as in that country they are as much looked to for keeping down the attack as Lady-birds are in our own as a check on Hop Aphis. Consequently burning stubbles, or burying them deeply, or other treatment which would kill parasites as well as pests, is thought doubtfully of. In the foregoing notes I have not entered on this consideration, because as yet we do not know that the parasite insects have followed in the train of the fly.

autumn brood is dead, is a most important precaution, but, as it appears to be safe if put in after the beginning of October, this point is usually met in this country without special arrangements.

Dressings, and mechanical measures, as rolling, &c., may or may not answer, according to circumstances.

All measures to secure good hearty growth, such as may carry the moderately injured plants through attack, are very desirable.

So is rotation of crop, as the fly only attacks certain cereals specified.

Strong-stemmed corn is less liable to attack than kinds of which the outside is more readily injured by the maggots.

The above methods of treatment mitigate the violence of the attack, and if in the coming season we find this injury, which has now for over a hundred years caused from time to time such devastating loss in America, has settled down here, we cannot do better than study in full detail the reports of observation and agricultural treatment which have been found to mitigate the evil.

But meanwhile it is most urgently to be considered, WHERE DID THE ATTACK COME FROM? As in the hundred years and more that it has been in America, and about half that time that it has been known in Europe, we have no records of its presence as a crop-pest; and plenty of records of it not being present it is reasonable to suppose that there has been some special circumstance which has not occurred before to which we owe its presence. To find what this is would be to find how to free ourselves from a most dangerous crop-pest, and if all concerned would examine into the various ways in which it can have been conveyed on the land, and will continue this watch and report on it in the coming season, we may hope to learn the source of the evil.

I will venture to add that I shall have pleasure in receiving any communication on the subject, or samples of infested grain, and also samples of winter wheat or barley considered to be infested, and in giving all information that lies in my power on the subject.

Bibliographical References.

The following list gives the titles of some of the publications in which information will be found regarding the original identification of the species of *Cecidomyia destructor* by Thomas Say, and likewise regarding its habits, history, and distribution in America and Europe, and means of prevention and remedy. The most important and serviceable of the papers are those of the U.S.A. Department of Agriculture, and the papers by Dr. B. Wagner:—

Some account of the insect known as the Hessian Fly. By Thomas Say. Journal of Academy of Nat. Sciences, i., pp. 45 - 48, 1817.

The Hessian Fly ; its ravages, &c. U. S. A. Department of Agriculture : Third Report of Entomological Commission. Washington, 1883. (Reprinted, with additions and corrections, from Bulletin IV. of the U. S. Entomological Commission. By A. S. Packard, jun., 1880).

The Hessian Fly ; its history, &c. By Asa Fitch, M.D. Trans. of the New York State Ag. Soc., vi., 1846. Albany, 1847.

The Hessian Fly not imported from Europe. By Dr. H. A. Hagen. Canadian Entomologist, 197 - 207, 1880.

Introduction to Entomology. By W. Kirby and W. Spence. 1815 - 26, i.

Untersuchungen über die neue getreide gall-mücke. Von Dr. Balthasar Wagner. Fulda & Hersfeld. 1861.

Die neue kornmade. Von Dr. H. Loew. 1859.

Naturgeschichte der schadlichen insecten. Von V. Kollar. Wien, 1837. English translation by J. & M. Loudon, with notes by J. O. Westwood. London, 1840.

Untersuchungen über Insectenschaden auf den schlesischen getreidefeldern im Sommer 1869. Von Prof. Dr. Ferd. Cohn.

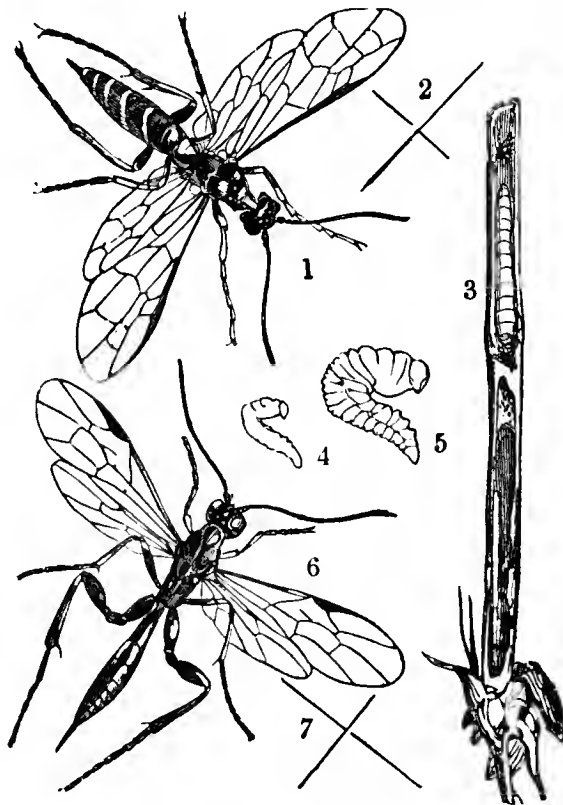
Die schadlichen insecten Russlands. Von F. T. Köppen. St. Petersburg, 1880.

Synopsis Cecidomyidarum. Von J. E. Bergenstamm und Paul Loew. Wien, 1876.

Die Praktische Insekten kunde. Von Dr. E. L. Taschenberg. Bremen, 1880. Pt. iv., pp. 9 - 14.

Die Pflanzenfeinde aus der classe der Insekten. Von J. H. Kaltenbach. Stuttgart, 1874. Pp. 734 - 741.

Corn Sawfly. *Cephus pygmæus*, Curtis.



CEPHUS PYGMÆUS, Curtis.

1, 2, Sawfly, magnified, with nat. size ; 3, stem containing maggot ; 4, 5, maggot, mag. and nat. size ; 6, 7, parasite fly, *Pachymerus cecitrator*, mag., with nat. size.

The injury caused by Corn Sawfly may be easily mistaken at a passing glance for that caused by Hessian Fly, as in both cases the

straw falls; but in the *latter* case it bends down at a sharp angle above one of the lowest knots; in the *former* (that is, in the case of injury from Corn Sawfly) the mischief is done by the corn stem being cut through about ground-level by the maggot which lies inside the stem; consequently the stem does not bend, but breaks clean off at the cut part.

Regarding this attack, Col. C. Russell wrote me, on the 20th of July from Stubbers, near Romford, Essex, regarding what turned out to be attack of *Cephus pygmæus* :—

“ I examined a lot of wheat-stalks like those I sent you. In two I found specimens of a very small insect; one inside the straw when I had opened and examined to the joint below, the other came out where the straw was cut in two on removing the sheath. They were long and narrow, and had a glistening appearance.”

On Aug. 12th Col. Russell forwarded two more specimens, which agreed with description of Corn Sawfly respectively in larval condition and in cocoon. The maggot was legless, with yellowish head and brown jaws. Col. Russell mentioned he had searched the wheat that morning and found “two larvæ of the kind which cuts the straw in two close to the ground. They were both *below* their cut. Though cutting the straw close down into the ground, I cut one larva in two. . . . The other larva is complete: as it is in a fine silk envelope, I suppose that it has ceased feeding, and is about to change.”

Relatively to distinctions observable between different methods of injury to straw, Col. Russell remarked :—“The sort which I now send cannot be distinguished from other fallen stems, except by pulling gently or feeling along with the finger-nail to the place where it has fallen. This is so close to the ground that when the straw comes away the stump is so close to the ground that it is apt to be lost sight of, and difficult to find again among the other stalks; and this is where the insect lies. It is therefore not easy to get the insect, especially as for one straw cut down by it perhaps fifty have fallen from other causes, as wind or weakness.”

A field of wheat at North Hall, Basingstoke, was reported by Mr. H. Purefoy Fitzgerald as being very badly infested by maggots, which were within the stems. The specimen sent accompanying proved to be the maggot of the Corn Sawfly; and on Aug. 25th Mr. Fitzgerald forwarded some wheat stems which showed on splitting up the straw where the maggot had worked and fed within.

The larva or maggot of the Corn Sawfly is of the shape figured at p. 26, of a yellowish white, with a horny rust-coloured head, and, contrary to the general condition of sawfly maggots, it is without feet, but at the tip of the tail there is a sort of tube-like appendage, or

extensile tip, which showed extremely plainly in Mr. Fitzgerald's specimen.

The life-history is stated to be for the parent sawfly to pierce the corn-stem and lay an egg within it. The maggot which hatches feeds within the tender straw, and, according to strength or circumstances, pierces through one or more knots, until when nearly full-grown it goes down again, and just about harvest-time cuts the straw through, or nearly through, with its strong jaws just about ground-level. It then goes down into the part below the cut, and there makes itself a kind of silken case (as observed at p. 27 by Col. Russell), in which it changes to the chrysalis-state, and from this the four-winged fly (figured at 1, p. 26) comes out in the following summer. The colours are chiefly black and yellow; the yellow is clearest and brightest in the male.

The damage is only partly caused by the sawing through of the stems. This causes them to fall, and makes confusion in the crop; but the great mischief is from the feeding of the maggot in the stem, having more or less stopped the proper formation of the ear. In the specimens sent me the marks and state of the stem showed very plainly where the maggot had been working within it.

As the maggot remains in its silken case down the pipes of the stubble left on the field, and the fly does not come out until the early summer of the following year the means of preventing recurrence of attack are very easy. If the stubble is scarified or skimmed so as to loosen it, and the plants then dragged and collected in heaps and burnt, the mischief is entirely put an end to. It would be worth while, where attack has been bad, to have the stray plants of stubble, which may have been left by the regular farming operations, hand-collected and thrown to the heaps for burning.

In this, as well as in Hessian Fly attack, it would be a most excellent way of getting rid of infestation, *if the thing could be managed*, to burn the standing stubbles after harvest. But the plan is difficult to carry out in this country for many reasons.

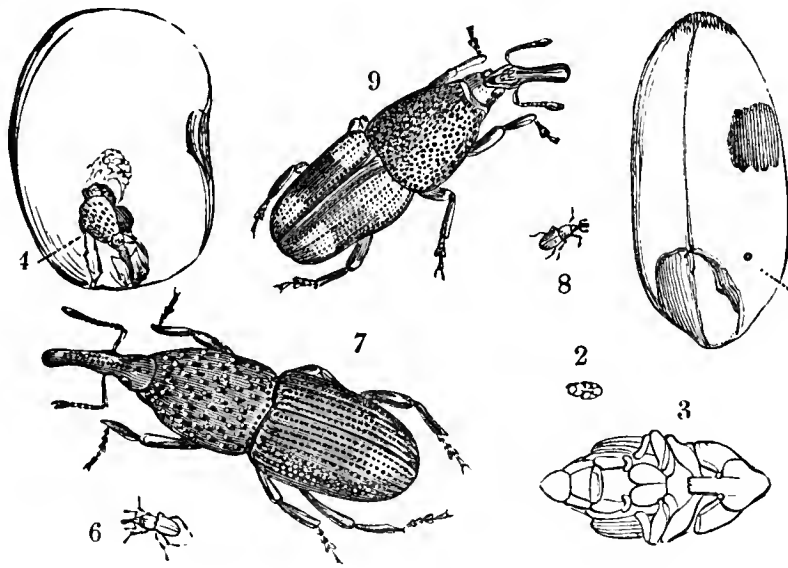
SCREENINGS.

Corn Insects of various kinds.

During the enquiries which followed on the first appearance of the Hessian Fly in this country during the past season, as to the possible methods by which this pest could have come amongst us, I was strongly urged to endeavour to direct attention to the great risk that is incurred of insect corn-pests being spread generally in consequence of the increasing use of screenings or injured corn, foul with all sorts

of insect-presence, being sold at very low rates, in some cases as feed corn for horses, sometimes as poultry-food. The samples showed me were what is termed alive with insects.

With regard to importation of Hessian Fly attack in chrysalis form, in this manner it appears unlikely, as Hessian Fly is not known



CALANDRA GRANARIA; C. ORYZÆ.

6, 7, Granary Weevil; 2, 3, pupa, nat. size and mag.; 8, 9, Rice Weevil, nat. size and mag.; 1, corn, showing puncture of entrance and hole of exit of weevil; 4, infested maize-grain.

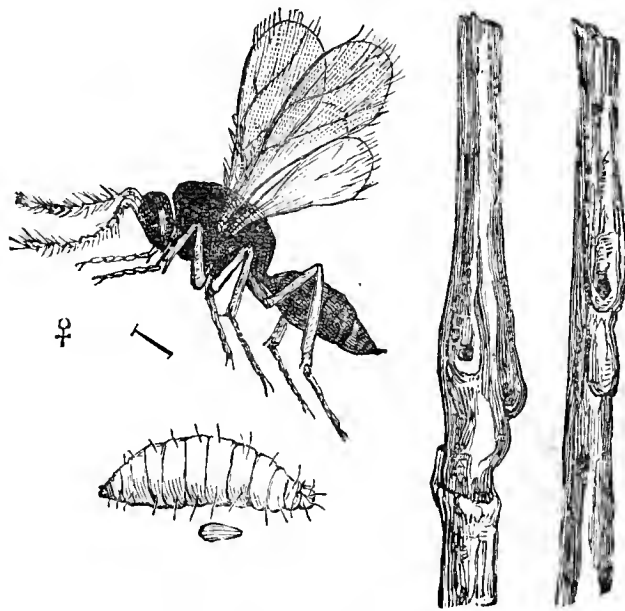
to attack oats, and, in the case of barley and wheat, the chrysalids would not be at all likely to be found in fairly cleaned grain. Investigation has shown that the chrysalids may be found in the dust and rubbish beneath the machine, but not, so far as we see at present, in the chaff or the cleaned corn.

But quite independently of Hessian Fly, the increased amount of spread of all the pests, insect or fungoid, which may be in these screenings, is a matter calling for consideration, and all the more because—though each sufferer sees what is going forward—there is a strong and natural objection to give information which may cause business annoyance; and it is most difficult to procure full details.

On application to the manager of a large steam mill, where imported wheat is ground, he obliged me with a series of samples showing the different kinds of refuse now sold cheap, mostly for poultry-food. These samples were of four kinds, known as “rubble,” which consists of bodies larger than the wheat-grains, as lumps of earth, maize, beans, &c.; first and second screenings, which consist of broken corn, bits of straw, chaff, &c., and other bodies smaller than the wheat-grains, or which may (like straw) pass by reason of their fineness through the screens; and, fourthly, there was “black dust,” which is literally, for the most part, mere dust driven by a blast from the grain in process of cleaning. In this black dust there

appeared to be very little insect-presence, nor did it appear to be of any use; it was formerly got rid of by being floated away down the river, until river regulations prevented this method of destruction.

In the screenings I found many granary weevils, besides other beetles, and in the rubble a good many lumps of grain, spun together by granary moth-caterpillars. Besides these there were in some of the samples short lengths of straw, which were quite long enough to convey the "joint-worm," one of the worst American corn-pests, and likewise there was the dangerous fungus "Ergot," which is objectionable as poultry-food, or as being thrown where it can be carried on the land. The various kinds of grain-beetles infesting corn and other stores is an old trouble, but the presence of bits of straw in which the "joint-worm" or maggot of the *Isosoma hordei* may perfectly easily be imported into this country is an evil which (as apparently there is no way of preventing the matter) it is as well to give timely warning of, and I therefore quote below some abstracts from the account given of this attack in the Report of the Entomological Society of Ontario for 1872, prepared by the Rev. J. S. Bethune, President of the Society.



ISOSOMA HORDEI, Harris.

Joint-worm fly and maggot, magnified, with nat. length. Galls on wheat-stems caused by joint-worm. After figures in paper quoted above.

This attack occurs to wheat, rye, and barley, and is known as that of the "joint-worm," by reason of the maggots feeding within the corn-stems, generally above the first or second joint. The female fly inserts her egg into the straw with her long ovipositor, and places one egg after another till laying is completed. This was observed about the 10th of June. The eggs soon hatch, and the maggots, which are footless, but furnished with jaws, begin to feed. Swellings or galls form above the joints in consequence of the presence of the maggots within, but, as these are wrapped in the sheathing-leaves, they are not observable until the leaves have been stripped away (see figure).

The damage is caused by the sap being abstracted both to feed the maggots and to form the galls, and the ears are consequently stunted, blasted, or shrivelled. The amount of damage may be a third or half the crop, or even the whole may not be worth cutting. It has been recorded in several parts of the United States.

The important part of the life-history to us is that the maggot, when full-grown, "for the most part continues unchanged till the following spring, when it assumes the pupa-state, and finally emerges as a four-winged fly in the month of June." (The fly is about the tenth of an inch long, with four transparent wings, and black, with legs of some colour between black and pale yellow).

From the above circumstance of the maggots remaining in the straw during the winter, there is a perfect possibility of the pest being transported either in imported straw, or relatively to our present consideration in short lengths of injured broken-off straw such as I have found in "rubble" or screenings.

The attack is of old standing in the States, but, as from some cause unknown we have already had one attack of old standing recently brought amongst us, it can at least do no harm to be on the alert in time against a second; and as in the course of last season information was given me of corn being observed with holes in the stems, there may be already reason for special watch.

The attack may be easily distinguished by the swellings or galls above the lowest joints (with round holes in them in case the insects have escaped), and also by the fly being *four-winged* and black.

Amongst the various kinds of corn and meal beetles to be found in screenings or corn stores, the most hurtful kinds are the granary weevils, figured at p. 29. I have seen them in such numbers that enough to half fill a good-sized wash-hand basin was swept up at once from under a heap of corn in a granary in Gloucestershire, and had opportunity of watching their powers of spreading so as to infest all neighbouring outbuildings.

The following observations regarding them were sent me during last season by Mr. G. L. Purchase, of Chichester:—

"Weevil have been very numerous in a corn-store here; they came there in wheat. The wheat was heaped on a wood floor. When it was turned the weevil were found in immense numbers; they spread over the floors, walls, and ceilings of the store. The corn had become very hot. When it was turned the weevil clustered on the top for a time, blackening the surface.

"An endeavour to kill the weevil by fumigating the store has not been successful. Those about the walls survived. Paraffin kills them, but it is said carbolic acid does not.

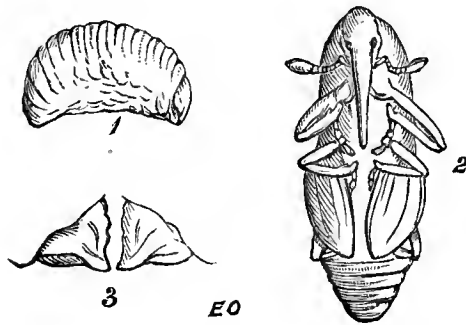
"Weevil are common in corn-mills, but, as the corn is frequently

changed, and the mills swept, the weevil do not become numerous ; but they are bad in a corn-store.

“ What will happen if they are not got rid of? It is said they cannot bear cold ; but if the insects die in the winter will their eggs be hatched next spring or summer ? ”

There are two kinds of weevils often met with in granaries ; the *Calandra* (*Sitophilus*) *granarius* (see figs. 6, 7, p. 29, natural size and magnified), and the *C. oryzae*. The first is the British or common granary weevil, and is of a chestnut or pitchy colour, and rather longer than the Rice Weevil, which last is further distinguished by usually having two orange-coloured patches on each wing-case. The method of life appears to be exactly the same in each case, and both kinds feed on wheat.

The egg was formerly supposed to be inserted into the corn by means of a hole formed by the proboscis of the female, but in observations made by Mr. Fitch and myself (of the habits respectively of the common weevil and the Rice Weevil) we found that a very minute



puncture was made in the corn, which Mr. Fitch considered to show that the egg was laid on the grain, and the minute maggot eats its way in. Only one egg is commonly laid on one grain, and the number laid has been found in the case of the *C. granarius* to amount to 120 in one week. The maggots are white, footless, fleshy grubs, with yellow or

chestnut-coloured heads, and strong jaws. The figure gives a sketch from life of the maggot (and its jaws) and the chrysalis of the Rice Weevil. The maggots feed and change to chrysalis within the grain, from which in due season the weevil creeps out.

The Rice Weevil is imported in vast quantities, and I have seen sweepings of corn-ships, known as “ Indian dust,” procured for me at Maldon by Mr. E. A. Fitch, alive with it. They have been stated not to be able to breed in this country, but from my own observations I have found that this is not the case. Eggs were laid and maggots fed in the grain, from which many beetles developed, but there is no reason to suppose that they breed here freely like the British kind.

Warmth is so much needed by the granary weevils that it has been observed that the common *C. granaria* will not pair when the temperature is below 52 degrees, and the beetles will live in the heaps of corn in hot weather ; but “ when the mornings begin to be cool all the weevils will desert the corn-heaps ” ; “ they retire into the crevices of the walls, into the cracks in wood and planks,” &c. (see Curtis’s ‘ Farm Insects.’).

The above remarks show the reason why thorough whitewashing, which gets at the weevils in the chinks where otherwise they would rest in peace till ready for further mischief, is of such great service.

The following observation by Mr. E. A. Fitch, of Brick House, Maldon, on the subject of prevention and remedy of this granary pest, are excellent:—

“Cleanliness alone will do the required work, and this requires to be thorough to cope with such a crevice and cranny-loving hibernating insect as the *Calandra*. Frequent lime-washing and scrubbing (with soft-soap) of granaries, and plastering of all uneven wall surfaces, and asphaltting or concreting of all uneven floors, the free use of the dressing-machine or blower, and frequent sifting or turning over of the grain, are the only remedies against weevil-attack. It is also necessary to guard against mixing sound wheat with any containing ‘weevil,’ except for immediate grinding; also to see to the destruction of all rubbish and tail-corn, in which it is possible for the beetles to live or breed.”*

The following information regarding granary weevils (also taken from the above-quoted paper) is of so much serviceable interest that I give it also in Mr. Fitch’s own words:—

“The wheats which are now affected to any very serious extent are the Indian, and I have often seen samples of the excessively dry Calcutta and South-eastern Asian wheat in which it was almost impossible to find a perfect corn, the valuable starch of the kernel being consumed by the destructive little weevils. *Calandra* like wheat and many other useful products, with their attendant evils, is undoubtedly an introduction from the East.

“Weevily wheat is invariably dressed after landing, and a large percentage of the little beetles are thus screened or blown out; but, of course, many of the insects resident in the corn, and all in the larva or pupa state, escape, the kernel not yet being light enough to be separated. When the cargo is very badly affected,—when the whole bulk seems alive, as I have myself seen them on very hot summer days,—it is a common practice for merchants to spout it, *i. e.*, to shoot the grain down a spouted trough, in which at the angle is a wire sieve with the meshes large enough to let the weevils through, but not the corn, which runs into the granary, or into sacks, as the case may be.

“By such means the quantity of weevils and dust sifted out is enormous, and this appliance is generally so situated at the wharves that the beetles are deposited near the edge of the wharf, or even in the river-bed, and, if not naturally washed away at high-tide, are

* See “Granary Weevils,” by E. A. Fitch; the ‘Entomologist,’ No. 189, February, 1879. Simpkin, Marshall & Co.

swept into the water, their destruction being thus easily accomplished. The great heat generated in a bulk of weevily corn is caused by the dust arising from the borings and frass of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot; then they are especially lively on the outside.”*

Other kinds of beetles, and various other kinds of corn-destroying insects, are to be found in screenings, refuse grain, neglected granaries, and the like places, of many of which the life-histories are fully known, and to some of which accounts the very significant remark is added by one of our best German writers on injurious insects, “Spread in course of traffic.”

So far as dry corn or meal-feeding kinds are concerned, the mischief is probably limited to the evil caused by their spread in the purchaser’s own stores or immediate neighbourhood. But with the kinds of which the maggot-state (that is, the feeding and destroying condition) is passed in the living corn crops, it is quite another affair. If bits of straw (such as I have before me in screenings), or knots of webbed corn containing chrysalids, or refuse containing infection in any other form, are thrown about in our farmyards, or stored where the evil may take wing and fly thence to our fields, an amount of trouble may arise well worth consideration beforehand.

“Tulip-root”; Eelworms. *Anguillulidæ* (? species).



Oat-plant, with “Tulip-root” disease.

The disease known as “Tulip-root” in Oats has either increased very much in amount during the past season, or has been very much more observed than in previous years.

* See p. 43 of paper quoted above.

The chief outward sign of this diseased growth is an enlargement of the base of the stem of the Oat-plant into a bulb-like form, from which the attack takes the name of “Tulip-root,” although the lower part of the diseased plant, taken altogether, much more resembles a “duck’s-necked” onion. Round this swollen base there are usually a number of short stunted pale-coloured shoots, each shoot crumpled and folded on itself, and the collection altogether forming a mass of rough irregular ends not unlike in appearance to a worn-down broom, whence possibly arises the name of “besomed” Oats, occasionally given to this form of attack.

These two conditions (that is, the swollen stem and the encircling distorted and stunted shoots) are commonly present, but when the diseased plants sent me were fully grown I have not found that as many stunted side-shoots were as observable as before; also in the very early stage of the attack (as seen in specimens of young winter Oats sent to me about the middle of November) I did not find even the “Tulip-root” swelling definitely formed. There was only at that time a small swollen knot or gall a little way up the stem. The infested plant was still in such early growth that, though many Eelworms were present, the diseased formations which they give rise to were only just beginning to appear.

Specimens of injured Oat-plants were sent to me at dates ranging from July 6th to Nov. 16th, thus showing the progress of the disease in the plants from about six inches high up to such maturity as they reached, and likewise (by means of the autumn-sown Oats) showing the appearance of the attack in an early stage.

The “Tulip-root” disease (so far as was reported) was much more prevalent during 1886 in Scotland than in England; it occurred in the shires of Renfrew, Ayr, Lanark, Linlithgow, and also in East and Mid Lothian; and the fact that these counties, or portions of counties, lie together (as, it might be said, “in a ring-fence”) may prove worth notice. It also occurred in Aberdeenshire, and also in the English counties of Yorks. and Berks.

As this very peculiar attack has not yet been much brought forward, I examined the specimens sent very carefully, to make absolutely sure that Eelworms were always present in the diseased plants, and have given the notes of examination in detail, although each is almost a repetition of the others, as the mere fact of this exact similarity of presence of Eelworms and of diseased growth always accompanying it is of practical use.

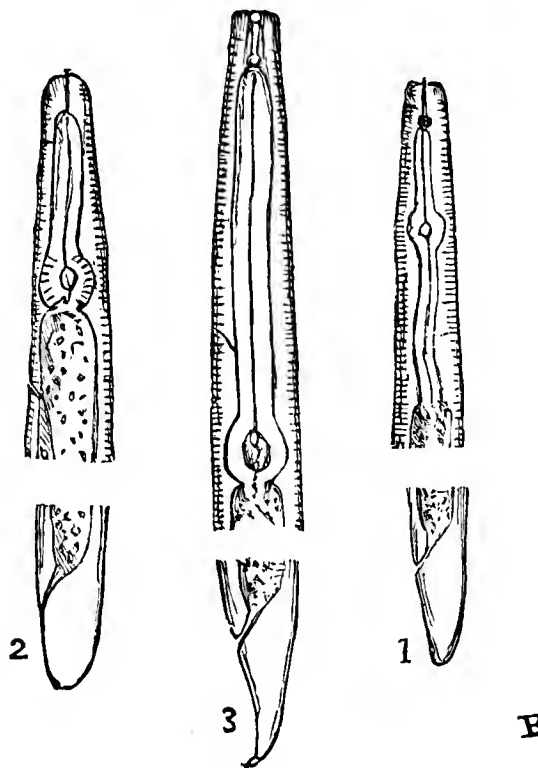
The inside of the bulb-like stem was more or less hollow, the surface of the cavity was often spongy, and, as the disease became worse, the surface became yellowish or brown with decay. On scraping away some of this spongy or brown matter I found this to be

the head-quarters of the Eelworms. I found wormlets also outside the bulb, amongst the sheathing-leaves, and likewise in the contorted stunted shoots. Eggs were not always present, but sometimes they were plainly distinguishable. (For shape see figure, p. 48.)

In the case of the very young Oats sent in November, I found Eelworms of various sizes present, but only a few that were apparently fully grown, and the " Tulip-root " growth was not then developed.

The Eelworms which cause this attack are excessively small, white, transparent, thread-like worms, so minute as to be invisible to the naked eye, and hatch from eggs. They belong to the family of *Anguillulidæ*, but at present we are not even sure which genus they belong to, nor (it seems to me) *whether there may not be several kinds present.*

The appearance of the diseased plants corresponds with that caused in Germany by the *Tylenchus dipsaci*, Kuhn. This species is very nearly allied to the kind which causes the purple galls in wheat known as " Ear-cockles," figured at p. 48. Several kinds of Eelworms are known to be found at the roots of Oats, and the figures of some of these given below may assist those who have a powerful microscope in making out what genus at least this pest belongs to.



ANGUILLULIDÆ.

- 1, *Tylenchus obtusus*; 2, *Aphelenchus avenæ*; 3, *Plectus granulatus*, of Bastian (all enormously magnified).*

It will be observed that the figures only give a portion of the head and the tail-ends; if the whole was present the wormlet would have

* The three species of Eelworms represented above are copied from the figures by Dr. H. Charlton Bastian, F.R.S., &c., given in Plate X. of his " Monograph on the *Anguillulidæ*," published in vol. xxv. of the 'Transactions of the Linnean Society.'

to be represented (at its present magnified width) as from at least eight or nine inches to a foot long. In fig. 1 it will be observed there is a spear or sharp point, with a large base, a swelling about half-way down the gullet, and the tail is blunt without a sucker. Fig. 2 has a spear without a large base, and the swelling of the gullet is quite at the lowest end; the end of the blunt tail has a very small sucker. In fig. 3 there is no obvious spear, the gullet is differently shaped, and there is a small sucker at the end of the pointed tail. These belong to three different genera or divisions as we may call them, and these and one other are alike in the power they possess of prolonged life, and recovery after being dried.* The common Eelworm of the wheat cockle-gall has been found to recover after being torpid for four or five years, and this capacity may have something to do with the appearance of patches of diseased growth in the Oat fields, where there has been no treatment to account for them in the preceding years (see map, page 42).

The following notes are arranged as nearly as possible in order of date :—

On July 6th Mr. Edm. Riley, of Kipling Cote, Market Weighton, sent specimens of Oat-plants, with the following remarks :—“ I have sent you a sample of diseased Oats. I have not had any on this farm before, but it was very common on some lands last year. This fine weather is improving crops much.”

These young plants were about ten inches high, the lower part of some of the main shoots was swollen into a bulb-like form, and the others contorted into irregular knotted shapes round the base of the tulip-rooted stem. These were mostly white, irregularly thickened and folded to and fro, as shown in the figure, p. 34. On opening the diseased parts, and more especially the swollen bulbs, it was observable (with the help of a magnifying-glass) that the inside had a sort of crumbly appearance, as if sprinkled with damp powder, and, on scraping some of this off and examining it with an inch-focus object-glass, it proved to be full of Eelworms in perfect vigour, with large numbers of eggs amongst them of the shape figured at p. 48. These *Anguillulidæ* were long, narrow, transparent wormlets, moving about in the glycerine in great numbers. The diseased Oat-plants sent did not look as if they were likely to get over the attack.

On July 16th Mr. Alex. Watson, of Dreghorn Mains, Colinton, near Edinburgh, forwarded specimens of Tulip-rooted Oats, with the mention that the disease was very prevalent in the county, and some remedy urgently desired; and on the 26th he communicated further as follows :—

* For source of above information, with full details, see Monograph by Dr. Bastian, previously quoted.

“ The field where these specimens grew bore two good crops of hay last year. This year, when Oats were sown, we gave it 3 cwts. per acre of an equal mixture of sulphate of ammonia and superphosphate. Considering the dry cold season it is a fair crop, where free of disease. The last white crop was chiefly Wheat, but about five acres were Oats, and it is there the disease is worst, showing that growing the same kind of crop too frequently is the cause of the disease. . . . It has occurred to me that it might be a good plan to pickle the seed with blue-stone, the way we do with Wheat.”

On examination of the Oat-plants forwarded by Mr. Watson I found them, as usual in this attack, swollen at the base, which was surrounded with small shoots, contorted from being checked in growth, and bent back to and fro on themselves. The first of these contorted shoots which I opened was slightly spongy in the middle, and a scraping from this surface showed the presence of *Anquillulidæ*. In scraping off the surface of the leaves as I removed the sheathing of the diseased bulb, I found just a few Eelworms, and in the small central cavity containing the minute growth, which I take to represent the future ear, I found a white mouldy look on the side of the chamber, which, on being scraped off and examined under the microscope, proved to contain many Eelworms, mostly of rather small size. I also found them in the decayed matter in the centre of the stem of this plant, lower down, about ground-level.

About ten days later (that is, on July 26th) specimens of diseased Oat-plants were sent by Mr. T. H. Cundy from the Ainsty Estate Office, Wetherby, with the mention that they were samples of the condition of about five acres of Oats taken out of the centre of a large field. This field was on magnesian limestone, with a fair depth of soil,—in Turnip the year before (pulled off); these were a splendid crop, grown with fold-yard manure from covered yards. This part of the field was manured again for these Oats, it being very poor and lying near the rock; it had only come into the writer's possession in the previous year. The Oats came well, but went back after two months of continuous dry weather. These Oats were very badly infested with Eelworms of various sizes; they swarmed too numerous to be counted, and one egg at least was visible. The diseased plants were as usual “tulip-rooted” in shape at the base with distorted shoots round; also on one stem there was a gall of twisted shoot growing from it a little above the base.

On July 19th Mr. Richard Brown furnished me with samples of diseased Oat-plants taken from two fields at Hill House, Kirk Newton, Mid Lothian. The plants from one field were much worse infested and their growth much more injured than those from the other. In those from the first-named field I found the plants were about six to

nine inches high, suffering from the usual form of diseased growth,—that is, the base swollen into “tulip-rooted” shape, with small crumpled-up shoots curled round the base for about half an inch in height.

On opening one of the curled shoots I found it was of a kind of spongy white condition within, in which I found a few of the worm-lets; the main stem of the same plant was swollen and hollow for about three-quarters of an inch up, the cavity being lined or partly covered within at the higher part with chestnut-coloured powdery or spongy matter. On examining this under the microscope I found that it was swarming with Eelworms, but I did not distinguish any eggs; Eelworms were present in the dark brown decayed matter at the base of the cavity, but there were not many specimens noticeable in this part.

I now tore off a piece of the inner side of a leaf-sheath about an inch and a half higher up, and where, excepting for being a little swollen, the plant looked well-coloured and healthy; and here, on taking a thin film of the silver-paper-looking surface, I found, with an inch power, that the Eelworms were also present. On cutting off a length of the central shoot at two to two and a half inches from the base, and unrolling just the central part, I did not distinguish that there were Eelworms present.

Eelworms were present in other Oat-plants taken from the same field, mainly in the discoloured yellowish part near the base of the stem, but I did not find—or rather could not be absolutely certain of the presence of—eggs. [The above specimens were examined in glycerine with inch and quarter inch powers.—ED.] The Oat-plants from the second field contained Eelworms also, but to a lesser amount, and the plants were less swollen.

With regard to these crops Mr. Brown mentioned:—“They are both crops following Turnips and Potatoes. Our crops following hay are not *this* year affected, those fields having been hitherto free of disease. A part of one field treated last spring with lime shows no abatement of the disease.”

Mr. Brown further mentioned, on July 26th, “that on observing the braird not looking well about a month ago, the worst parts received a top dressing of nitrate of soda, but this did not appear to check the progress of the disease. The plants which you describe as not quite so badly affected were taken from a field which was a little later in being sown than the other.”

On Aug. 23rd Mr. Brown reported the widespread prevalence of the attack:—“I find that disease is more widespread than I had thought. I have learnt of cases this year in Lanarkshire, Renfrewshire, East Lothian, and Aberdeenshire; in this district it is very prevalent, as

also in the adjacent county of Linlithgow." Also, as below quoted, he again noted that no benefit resulted from application of nitrate of soda as a remedy; benefit, however, had followed on use of sulphate of potash. He noted that a farmer, "after trying, on a field badly affected with the disease, a top-dressing of nitrate of soda without beneficial effect, applied half a cwt. per acre of sulphate of potash, which immediately checked the work of destruction, and brought the plant away, so that the crop has reached quite an average. A small portion not treated in this way is a failure from the disease. It may be that sulphate of potash, applied when the Eelworms are active, acts as a poison. It does not appear, so far as I can learn, to harm them when applied with the seed."

"I cannot find any indication that the extent of the attack is dependent upon the crop preceding the Oat, or of any other cereal crop being affected in a similar way. Neither can I find anything to show that the disease is communicated by means of straw from an affected crop applied as manure."*

On August 22nd Mr. Robert Drennan wrote to me from Goatfoot Farm, Galston, Ayrshire, as follows:—"A good part of my farm is holm land, in fair condition and wrought on the four-course system, which means a crop of Oats, a green crop, a crop of Oats or Wheat, and a hay crop. For several years I sowed Beans as part of the green crop, and I found the 'Tulip-root' much worse on the plot where the Beans were; so I gave up sowing them, and, although the land has gone through a course of cropping, the beaned plots are worse than the other portions of the field still."

Mr. Drennan further observed that he had thought that Beans preceding Oats was a cause of the attack, but also he mentioned that where the Beans were sown he took an Oat crop following. "The other portion of the field was Wheat, which meant two crops of Oats in the four years on the Bean plot, and one Oat crop on the other."

Relatively to the point of *Anguillulidæ* being possibly found about both Oats and Beans, he forwarded to me some stumps of Bean plants off land where "Tulip-root" had been bad the previous year. I examined these carefully for presence of "Tulip-root" *Anguillulidæ*, but could not find any present either in the roots or lower part of the stems or attacked earth,—in fact, they appeared to be completely absent. Mr. Drennan notes that he sowed his "Beans with about 3 cwt. to the acre of sulphate of potash with other manure. If sulphate of potash be a cure, that may account for the absence of the worm."

I take the liberty of inserting the following observations on the

* Observations as to methods of transmission of attack, and length of time which it may continue in the land, will be found at pp. 45 - 47.

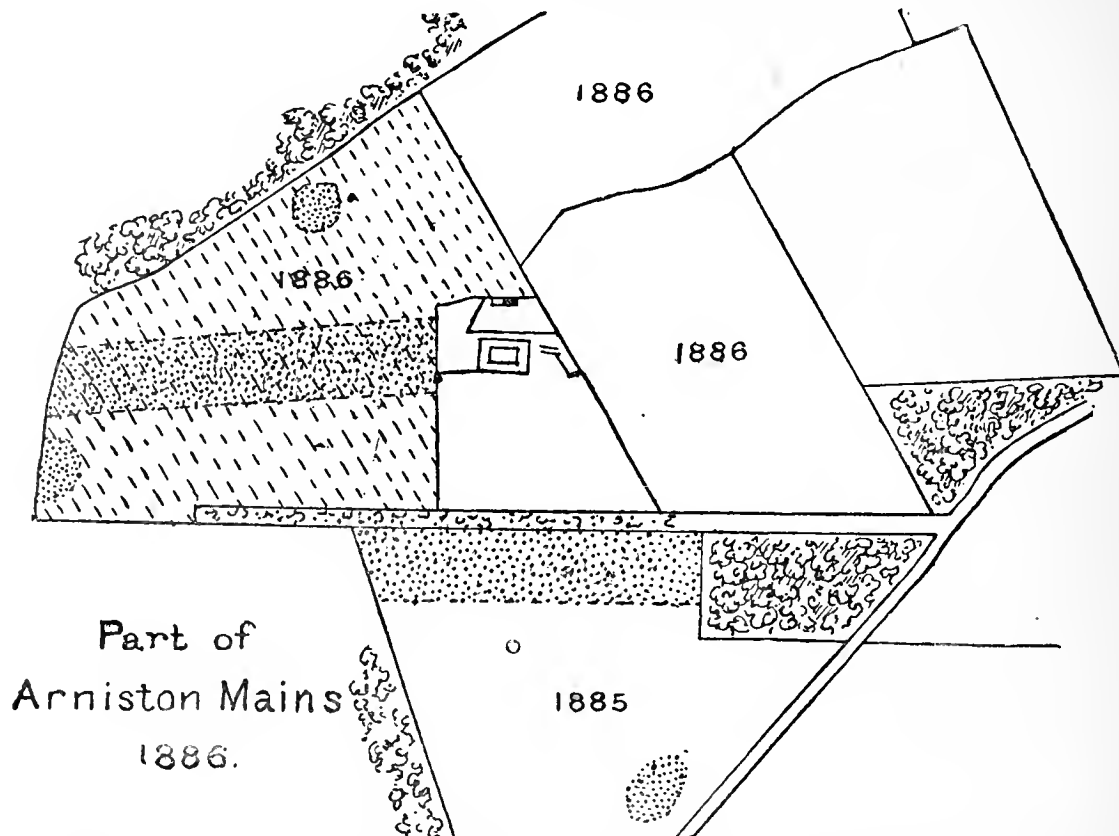
condition of the Oat crops at the Highland and Agricultural Society's Experimental Station at Pumpherston, reported on the occasion of the annual visit by members of the Society, as it is of great interest regarding the use of phosphates in connection with “Tulip-root” disease. I am obliged to the Editors of the ‘North Brit. Agriculturist’ for a copy of these notes which appeared in the above Journal:—

“The crop this year is Oats after Beans. Owing to the excessive drought this season the Station, in common with many fields under Oats, has suffered considerably, so that what is called by farmers ‘Tulip-root’ is somewhat prevalent. The observations drawn from this disease on the Station show that where the most liberal application of manures was made the disease was at its lowest, while those parts of the Station from which manures of a certain kind had been withheld, or only sparsely laid on, were most affected by the disease. The best plots on the Station were those to which soluble phosphate had been applied. Amongst undissolved phosphates bone-meal was, upon the whole, most effective; but there was little difference between dissolved phosphates from any source. Muriate of potash has this year produced a better result than sulphate. Amongst other manures, fish-guano, which hitherto has not been prominent, has produced one of the best crops on the Station, and nearly free from disease. Dr. Aitken suggested that this was probably due to the residue which had been left in the ground from the manuring of former years, this plot having been noticed to be improving year after year. The plots manured with superphosphates show, as in former years, that it is not advantageous to use phosphates whether too little or too highly dissolved.”

The following notes, with the illustrative sketch-map accompanying, show attack occurring in two fields (in two different years), on areas so perfectly regular in form that the two strips might have been separated by a ruled line from the rest of the fields. Mr. Dundas, after noting that he had heard of four fields in the neighbourhood affected by “Tulip-root,” remarked:—

“I enclose a tracing of part of my farm on which the disease has appeared, this year and also last year. On the plan the places marked in brown are those affected. You will see its course last year in the field marked 1885. This year the three adjoining fields marked 1886 have been under Oats, but only one of the three has been affected, the crop being Oats after Turnip. I have made every enquiry about the dunging, especially asking if the disease had been noticed, on however small a scale, in the years before 1885–86, but I am assured it had not been noticed; because in that case the infection might have been given to the land through diseased straw in the dung. Further, my steward has marked in the affected field 1886 the direction of the

ridges (and which also would be the direction in which the heaps of dung would have been laid down), but the track of the disease" (as shown by the dotted parts) "has no relation to the way in which the



The two infested strips and three small patches are shown by dots.

dung was laid down on the land. The other two fields marked 1886 were Oats this year, a level crop and free from disease."

The continuance of this attack up to the maturity of the crop, or rather to the time when, if all had been well, it would have matured, was shown by the specimens of Oat-plants sent from Arniston, Gore-bridge, Mid Lothian, on Sept. 24th by Mr. Robert Dundas, with the accompanying observations:—

"I enclose you a sample of Oat-roots from a field on my home farm, of which four acres out of twenty-two have been affected. The soil is a sandy clay; the crop is Oats sown out with grass and Clover seeds after Turnips." . . .

The stems proved to be in some instances hollowed or filled with decayed matter down to the roots, and the inside of the side shoots was also occupied by decayed matter. On examining this damp powdery-like matter I found many *Anguillulidæ* still alive and some eggs. In one of these I detected the developed wormlet folded on itself within. The Oats were much damaged, for many of the shoots were stunted and quite killed,—fairly gone in brown decay and black within,—and in this decayed matter I also found wormlets.

In this case, and also in one or two others, there was presence of maggots of some kind of small two-winged fly in the infested stems, and in one instance this occurred to such an extent as to appear at first to be the reason of the plant going off; but the coincidence may

conjecturally be caused by the fly being attracted to lay its eggs by the decayed matter in the infested plants.

The following observation refers to the presence of Eelworms in the young winter Oats. On Nov. 13th Mr. W. Farrant wrote from Stokes Farm, Wokingham, Berks, as follows :—

“ I herewith enclose a few plants of winter Oats. I put them in after one year ley of artificial grasses, mown once, the after-math fed. I drilled three bushels per acre, and I should say quite one-third are turning yellow as the sample sent, and some are eaten off. . . . It appears to me to be eaten off inside, about half an inch from the seed. . . . I may say that I anticipated wireworm before sowing, and sowed 10 bushels soot, 3 cwt. salt, and 2 cwt. fish-bone per acre. Sown behind the drill and harrowed in with the seed, and rolled with a light roller.”

On Nov. 16th Mr. Farrant furnished me with some more specimens, and I examined both the tops and the rootlets. There were no Eelworms observable about the rootlets, but on breaking up the sprouted grain in water together with the husk surrounding it, I found Eelworms of various sizes numerous present, and they were also to be found in numbers on breaking up the stem about half an inch above the seed. There was no growth advanced far enough to have gained the “ Tulip-root ” form, but a small knob of thickened growth was already observable at about the highest part of the diseased, or rather the infested, portion of the stem just above the grain. The Eelworms were in very active condition, and were in some instances apparently fully grown, but the larger number were from about one-sixth to half the size of the full-grown specimens.

The above note from Mr. Farrant completes the series of observations of presence of Eelworms in Oat-plants, or amongst the lower part of their leafage, from *almost* the first start of the plant from the seed up to maturity; and if we could have some specimens of Oats just at sprouting-time itself for examination, it would be likely to throw a good deal of light on the first stage of possession by the Eelworms. If we found them present in the husks of the seeds it would appear that they had come there either from the infested ground or manure in it, or from the seed itself. We have no reason to believe they are in the substance of the seed, but (wherever they come from) it appears worth consideration whether, as suggested by Mr. A. Watson at p. 38, the use of a sulphate of copper steep, commonly known as blue-stone, or pickle might not be of great use. The poison or flavour of the pickle would be likely to remain quite long enough about the grain to be a powerful deterrent to attack. If on examination of the soft sprouting grains the eggs of the Eelworms, which are very easily known by their shape, should happen to be found, we then should

have the key to the attack; but, as we have no notes of Oat-grains being galled like those of Wheat, it does not seem likely that we shall find the attack comes from inside the grain.

On looking over the observations we find that the "Tulip-root" disease has been found to occur to Oats after Turnips, Potatoes, and Beans, also on land broken up after Hay, and it is specially noted in one instance that the part of the field which had previously been in Oats was the worst attacked by "Tulip-root" in the successive Oat crop.

The above observations point at least to probability of the Eelworms remaining in the ground, or being brought on to it in infested straw; but we need details and further observations.

It will be observed that lime, nitrate of soda, soot, and salt have not proved of use in warding off attack.

In any further observations with which I may be favoured, I should be particularly glad to know whether the attack has been limited (as in that of which the plan is given at Arniston Mains) to any particular part of the field; and also to have details of previous crops and manures for the preceding five years, this being the length of time to which it has been proved that the life of one kind at least of the common crop Eelworms may be extended.

In the above report it will be noticed that I have limited myself almost entirely to observations on the diseased crops, as I had not then the very high microscopic powers needed for any trustworthy examination of such excessively small bodies as these Eelworms. I could clearly distinguish that the egg was of the shape figured at p. 48, also that the largest-sized Eelworms were furnished with a spear, but whether this had a trilobed base, or, in fact, any swollen base at all (see figs. and description, pp. 36 and 37), I had not then means of observing. Now I have procured these, and shall be very glad of any specimens with which I may be favoured, either of Tulip-rooted Oats or of "going off" Clover. From my own observations of injury and from information now received, I think it very likely that a searching examination of diseased Clover might show Eelworm-presence of the same kind as the "Tulip-root" Eelworm, and infectious from one plant to the other.

But further from the great difficulty of procuring any reliable information in England as to the nature and treatment of the "Tulip-root" attack to Oats, or the precise species of Eelworm which causes it, I ventured, whilst the previous pages were going through the press, to apply to Dr. J. G. de Man, Conservator of the Museum, Leyden, now resident at Middleburg, in the Netherlands, well known for his researches regarding the *Anguillulidæ*, and beg to acknowledge with

many thanks his prompt and courteous, as well as most efficient, attention to my request.

Dr. de Man was good enough to examine some specimens of diseased Oat-plants which I forwarded to him, and, besides a few living *Anguillulidæ* of the genera *Dorylaimus*, *Cephalobus*, and *Rhabditis*, which he considered to be living on the outer surface of the plant, “probably in small earth-particles adhering to it,” he likewise found *Tylenchus* present in the plant, but nearly all dead. As all examined were young and not yet developed, absolute certainty could not be attained as to the precise species, but it was presumable that they were of the *Tylenchus devastatrix*, Kuhn, which is one of the synonyms of the *Anguillula dipsaci*, afterwards the *A. devastatrix* of Kuhn, of which the attack is shown in the following extracts from Dr. Kuhn’s treatise to be like that we are now suffering from in Britain.

In this matter it is of great importance to ascertain the kind of Eelworm which is present relatively to the extraordinary powers of prolonged life possessed by some of the divisions of the great family of *Anguillulidæ*; therefore, to know that our kind is a *Tylenchus* is of much use.

In the following extracts from Dr. Kuhn’s treatise it will be seen how nearly the German attack to Rye and Oats corresponds with ours, and, though it has been mainly reported from observations on Rye, that the treatment is equally applicable to either crop.

The following notes and extracts up to p. 47 are extracted from Dr. Kuhn’s pamphlet of observations on ‘The Worm-sickness of Rye’:—

This disease, which is known as “Stem-sickness,” or shortly as “Stem,” “Knob,” or “Root,” agrees very exactly in its effects in the most marked form with our “Tulip-root.” The experiments and observations mostly refer to Rye, but Dr. Kuhn has found by minute examination that it is one special kind of Eelworm (formerly observed in Teasels) which causes the disease he reports on in Rye and Oats, and likewise attacks Clover, Buckwheat, and the Fuller’s Teasel. For this reason he changed the name from *Anguillula dipsaci*, or “Teasel Eelworm,” which had ceased to be appropriate to *A. devastatrix*, as showing its widespread injuriousness.

This special kind has been found by Dr. Kuhn to regain vitality if moistened with water even after two years laying up dry. But further, which is enormously important to the present subject, he states that “in damp earth they preserve their power of living still longer, even if their food-plants should perish. This circumstance is to be attended to in combating the Eelworm disease.”—J. K.

All measures found serviceable for prevention of this "Stem" or "Stock" disease turn on observed habits of the Eelworm.

This kind is found by Dr. Kuhn to infest Rye, Oats, Clover, Buckwheat, Fuller's Teasel, and also the field-weed often met with in chalky fields, known as "Corn Bluebottle."* As far as is known it does *not* infest Wheat, Barley, Peas, or Flax. The fact of infection being carried in worm-infested plants to some kinds of corn but not to others, was proved by the following experiment of Dr. Kuhn's. He buried small pieces of infested Teasel-heads an inch and a half deep in the ground, and sowed over them different kinds of Wheat, also Barley and Rye; and of these crops the Rye was infested, but *not* the Wheat or the Barley.

Rotation of crops is therefore very important, but as it has been proved that the Eelworms can live on in the land, even without their own special food-plants, the following treatment, which is advised by Dr. Kuhn for burying them so deeply down that they can do no more mischief, is well worth consideration:—

"The surest remedy for worm-sick fields consists in late ploughing, sixteen or eighteen inches deep. By this treatment the upper layer of earth with the contained *Anguillulidæ* is buried deep, and is covered with a full spade's depth of the under soil. The treatment must be carried out in autumn, and in the next spring cultivation rich manure given to the crop. It is most desirable that this should *not* be of stable manure, which it is very possible may contain Eelworms, but rather of guano and superphosphate. Carrots and Potatoes succeed best in the late-ploughed land. Should notwithstanding the worm-disease appear again at the same places in the fields, the spots should be dug anew deeply, two spades deep; we can also prevent the spread of these wormlets by isolating, by means of a trench of a foot and a half deep and a foot across."—J. K.

With regard to different methods in which the wormlet infection may be spread, it is shown by Dr. Kuhn that one way is in earth from infested fields. This is shown by an instance in which a man, to mark his disbelief in the possibility of such transmission, had earth from Eelworm-infected land spread on what was clean before, and thus set up attack. It is also noted that the infection may be spread in earth *carried* from infested land (that is, by earth adhering to agricultural implements, to the hoofs of horses employed on the foul land, or to the shoes of the agricultural labourers).

The danger of transmission in manure is most particularly noticed by Dr. Kuhn. He mentions:—"It is to be observed that the *Anguillulæ* can make their way in short haulm to the spindling ear. These worm-infested plants, which are cut with the scythe, later on

* *Centaurea cyanus*.

go into the manure. Such manure, found to be of straw-litter from wormlet-sick fields, *ought not to be carried* to fields which may still be free from disease. We can thus at least ward off new infection from the fields. It is only on very heavy land that such manure may be applied without consideration, because here the wormlets cannot cause important injury on account of the physical nature of the soil being unfavourable to their spread.”—J. K.

(This matter of transportation in manure is very important, and, though I cannot here give at length Dr. Kuhn’s various very practical cautions, the above examples warn us as to possibility of bringing in infection in Clover and other crops besides Oats, and likewise some in weeds. The Corn Bluebottle is named as a very fertile source of infection, and wild grasses as open to suspicion.) Dr. Kuhn concludes his valuable pamphlet with this summary:—

“ Deep cultivation, rich manure, but with care not to use wormlet-infested stable-manure, and suitable rotation of crop, are the best methods for combating this evil; their application consistently carried out will be certain to succeed in time.”

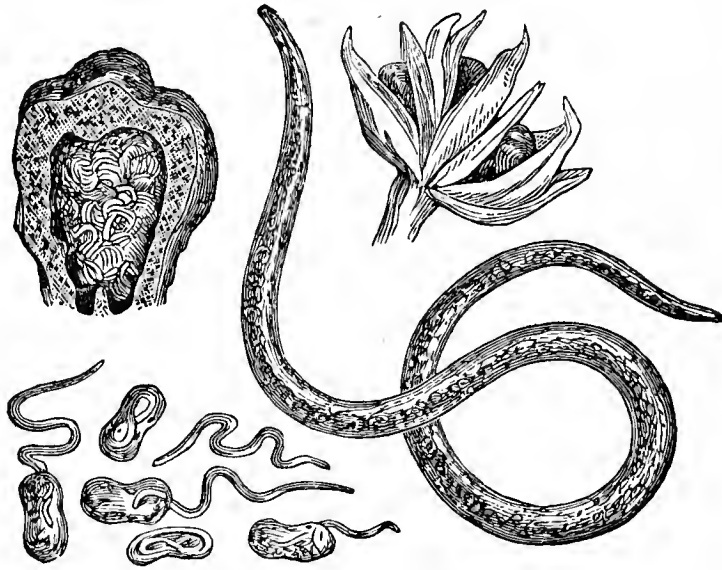
(The above information is taken from Dr. Jul. Kuhn’s Monograph on ‘The Worm-sickness of Rye,’ and mainly from the two last pages.)*

The above extracts show the extraordinary length of time to which the Eelworms can live; the ease with which they may be carried in infested earth; the certainty with which they may be carried in manure made with infested straw, or into which infested plants, whether crops or weeds, have entered; the importance of rotation of crops, and also (as it appears some kinds of crops have not been known to be infested) the importance of saving all present trouble by putting an Eelworm-proof crop into infested land; the serviceableness of deep ploughing and digging so as to turn the pests down to a depth from which they *cannot* come up again; the serviceableness also of good measures of cultivation to push on growth, and of good firm land in which the wormlets *cannot* travel; and, lastly, we learn that in seeking the cause of presence of the disease we may have to go back several years for the reason of the original infestation.

Through the kind assistance afforded me I shall hope to be able to add further information as to the exact species of Eelworm now doing us so much injury.

* The name in full of Dr. Kuhn’s work is ‘Ueber die Wurmkrankheit des Roggens, und über die ueberunstimmung der Anguillulen des Roggens, mit denen der Weberkarde,’ von Dr. Jul. Kuhn. Halle, 1869.

Wheat-ear Cockles ; Eelworms. *Tylenchus tritici*, Bastian ;
Vibrio tritici, Curtis.



Wormlets escaping from eggs; section of Cockle-gall, with wormlets within after Brauer's figs. (much magnified). Spikelet of Wheat, with galls (magnified). *T. tritici* wormlet (greatly magnified). Nat. length of largest one-seventh to one-fourth inch.

The purple galls sometimes found in great numbers taking the place of healthily-grown grain in ears of Wheat are caused (as well as the "Tulip-root" disease mentioned in the foregoing pages) by Eelworms. The above figure gives a general idea of the wormlets and of the eggs enormously magnified, and the latter may easily be known by being rather smaller in the middle than at the two ends.

At the end of August a bunch of Wheat-ears, almost ruined by the amount of Cockle-galls present, was sent by Mr. Price Jones, of Elm Green, Cirencester, who mentioned that he found presence of this Cockle-gall attack in Wheat in three fields covering together about twenty-seven acres. In one field, in a space of about two or three acres, the infested ears occurred rather frequently, perhaps two or three in a square yard. Over the rest of the ground they were far fewer, requiring some care to find them. It was remarked that this blight had not been noticed before by the farm-labourers.

Specimens of Cockle-gall in Wheat-ears were also forwarded on the 6th of October from Framlingham, in Suffolk, by the Rev. W. W. Tyler, with the mention that they had been brought to him as being rather common this autumn in several fields in the neighbourhood. Most of the Wheat-ears sent were very badly infested; in one which, by way of experiment, I rubbed out there did not appear to be any good grains, and the Cockles might be estimated at fifty or sixty. On splitting one of the galls and placing it in a drop of water the vast numbers of wormlets within (which were all collected together, as shown in the magnified section of a Wheat-grain figured) swelled up and overflowed in countless numbers on the microscope-slide.

These wormlets are male and female, and multiply by laying eggs. As their history was given in my last year's Report, from Dr. Charlton Bastian's valuable Monograph, there is no reason to repeat it now; but the method by which attack has been found to be set on foot is of considerable interest, both with regard to the Wheat-cockle, which it refers to, and also with regard to "Tulip-root" disease. "When the infested galls are sown together with healthy seeds the young in a week or so, according to the degree of moisture of the soil, make their way out of the softened gall, and, diffusing themselves in all directions, some come at last into contact with the budding plant just sprouting from the healthy seed, and then insert themselves between the sheaths of its leaves, gradually working their way round till they come to the innermost of these, where they remain for a variable time without increasing much in size till the rudiment of the future ear begins to form." . . . *

As the Ear-cockle worms appear to live in the galls in the Wheat-ear, excepting during the time when they are transferring themselves from the "Cockles" which have been sown with the seed to the sprouting plant, where they establish themselves as soon as possible in the embryo ear, it is evident that repetition of the attack may be prevented by being careful not to sow grain infested by "Cockles." They are easily distinguishable by their purple colour, and suspected grain may be tested by throwing some handfuls into water. I have not found in my own experiment that there was a single "Cockle" which did not float, whilst the good grain sank to the bottom.

Sulphate of copper steep has been suggested as a remedy, but the mere placing the grain in water without any chemical admixture, and skimming off the "Cockles" as they floated, would be a simple way of getting rid of the infection.

Wheat-bulb Fly. (? *Hylemia coarctata*, Fallen.)

The following communications refer to injury to young Wheat occurring to a serious extent after summer fallow or Swedes, and apparently caused by the maggot of a small two-winged fly.

Early in May I received specimens of infested Wheat-plant from Major Salmon, of Tockington Manor, Almondsbury, Gloucestershire, requesting information regarding the attack, as "large fields of Wheat have been seriously affected by the action (as he supposes) of the insect which will be found attached to the plants enclosed."

* "Mon. on the Anguillulidæ," by Dr. Charlton Bastian, 'Trans. of Linn. Soc., vol. xxv.

The specimens enclosed were maggots of some kind of small two-winged fly, of pale yellow or whitish colour, up to a quarter of an inch in length, smaller towards the head-end, which was furnished with strong black or dark brown mouth-hooks, and truncate or roundedly truncate at the tail.

The infested corn was injured by the maggots eating within and gnawing out the inner part of the shoots just above the bulb, and for some little way above. A small hole or slight tear was observable in some instances, this very possibly showing the spot where the maggot had made its way out when travelling.

In reply to further enquiries Major Salmon favoured me with the following details, which I give at length, as similar attack is reported every year, and at present we have not got information enough to enable us to deal with it:—

“ 1. The soil is marl, one of the last pieces of rising ground where the limestone hills fall down to the level of the low levels which extend from here to the Severn; just above where the pasture-lands of the level proper begin.

“ 2. Date of sowing of the Wheat, last November.

“ 3. Manure: a rather heavy dose of farmyard manure was given to the land before the crop that preceded the Wheat.

“ 4. Course of cultivation where this Wheat grows was, in 1883, fallow; 1884, Wheat; 1885, part Swedes, part Mangolds, part Vetches, part Potatoes; for the field is a large one.

“ It is remarkable that these maggots are not to be found in any part of this field, except where Swedes were grown last year; and that the maggots are incomparably more numerous and destructive in those parts of the Swedes where the Swedes *failed* last year. Where the Swedes were the worst the Wheat-plant is the most affected; and where there were other crops than Swedes last year the maggot is hardly to be found.

“ It is also to be remarked that the tops of the ridges (*i. e.*, where the soil is the hollowest from the plough having thrown up the two ridges together from opposite directions) are more affected than the ridges below these or in the bottoms. . . . The maggot seems new to the neighbourhood, but I have just heard that another of my tenants has found a few in some Wheat of his on land where he also had Swedes last year.”

The following note sent from Croft Wainfleet, Lincolnshire, on May 7th, by Mr. John Searley, refers to similar attack:—“ I enclose a sample of Wheat-stems eaten into by a small white worm. Wheat on land summer fallowed last year has suffered most in this district, where the soil is clay and mixed clay and sand reclaimed from the sea.”

On May 28th Mr. Searley furnished me with the details of tillage and succession of crops on the infested ground as follows:—"I have seen other summer fallow wheats fail this spring, but none of my neighbours have seen the grub. I will give the main tillage operations in field attacked.

"1884.—Wheat a good crop, but weedy; many common thistles. Ploughed in winter six inches.

"1885.—May, ploughed back.

"July, again ploughed and thoroughly dragged and harrowed to kill twitch. Left rough.

"August 4th and following days manured with well-trodden straw from bullocks eating cake in previous winter.

"Aug. 8th, ploughed and rolled.

"Aug. 10th, rolled and drilled with white mustard and 2 cwts. of mineral phosphate and bone-meal. Land was so dry that mustard did not come up until late in September. Little eatage (kept 100 sheep a fortnight on six acres).

Nov. 9th and 10th, ploughed and drilled with eight pecks of Main Stand-up White Wheat; seed not affected by this grub in previous year.

"1886.—Rolled in March; Wheat looking well for a sharp winter, —in fact, as well as rest of the farm. Wheat began to fail about April 10th. Grub not found until sent to you.

"Remaining eight acres of field tilled in same way in 1885, but sown with rape, which also failed, is *not at all* affected by grub.

"May 26th, many bare spots in Wheat, some roots which did seem dead sending up shoots after rain. Grub cannot be found."

The attacks above mentioned appear to be of just the same kind as those reported in 1881 and 1882,* but the only thing which seems clear as to any preceding points is that they usually occur after summer fallow, or after Swedes of which the crop has failed. In the report given above by Mr. Searley attack in one case was worst on land where there had been an unsatisfactory crop of Mustard eaten off by sheep.

In the instance in which the fly was reared from infested plants (in 1882) it proved to be a little greyish fly, somewhat like the Onion Fly in general appearance; and the following is its winter life-history, as given by Dr. E. L. Taschenberg from observations on attacked Rye injured by the two-winged fly, *Hylemia coarctata*:—

"I have only observed its method of life in the winter brood, for which the females laid their eggs in autumn in the winter-sown plant—in the last days of March I found the maggots in the heart of the

* See 'Reports on Injurious Insects for 1881,' pp. 18-20, and for 1882, pp. 20, 21, by Eleanor A. Ormerod.

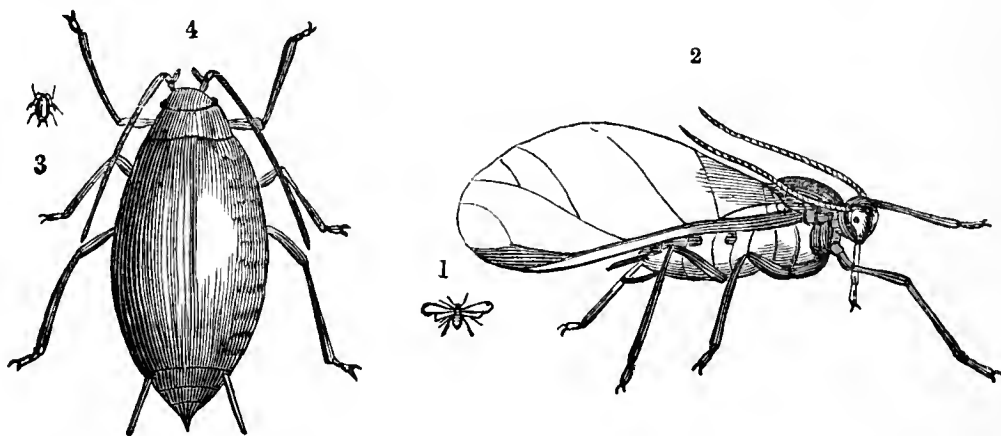
Rye-plants, the leaves were yellow at the tips, and gnawed and decayed at the root so that the heart-leaves could be drawn out. By the 25th of April some maggots were going into the earth to change to chrysalids, and by the 9th of May both chrysalids, and maggots nearly ready to change to chrysalids, were observable. From the 20th of May onwards the flies appeared in the early morning, at first only males, afterwards females; they appeared up to the 8th of June, and still some chrysalids remained.”*

Dr. Taschenberg further observes “that this widely-distributed and common fly develops at least one more brood is evident, but how and where I have not yet made out; whether it may resemble the winter attack, only be in grasses allied to Wheat, or may come from manure, or where?”

This is what we still need to make out. It is plain, as previously remarked, that the fly that lays its eggs on the young Wheat sown after summer fallow cannot be the same fly that came out in June; but where the intermediate generation has fed in maggot condition, and changed to chrysalis and fly, is what we need to know before we can deal with this attack.

H O P.

Hop Aphis, and Damson-Hop Aphis. *Aphis (Phorodon) Humuli*, Schrank; and *Aphis (Phorodon) Humuli*, var. *Malaheb*, Fonsc.



APHIS (PHORODON) HUMULI.

Winged and wingless Hop Aphis; nat. size and mag.

The following observations are merely given to record the great amount of Hop Aphis which appeared late in the season; as it may prove of use to notice whether this is followed by absence or presence of Hop Lice and Fly next spring.

* ‘Praktische Insekten kunde,’ von Dr. E. L. Taschenberg, pt. iv., p. 120.

On Sept. 8th I received the following note from Mr. D. Turvill, of West Worldham, Alton, Hants, with regard to the serious injury caused to Hops (when the crop was almost ready for harvesting) by a great appearance of Aphides :—

“ Here we are in the first week of the ingathering of this crop, and to our astonishment they are turning visibly before our eyes, red and redder every hour. The cause is not far to seek. There has been a late attack of Aphis, and immediately the cones develop themselves the larger Aphides (wingless females ?) forsake the foliage and enter them, and, by sucking the short stem of each seed-wing or scale, reduce it to a desiccated state that under the hot sunshine of the past few days becomes rapidly withered and brown. Also we may be engendering the progeny for a severe attack next spring, if the conditions of hybernation should be favourable.”

On Sept. 30th Mr. Mark Sandford, writing from the Pond, East Peckham, Tunbridge, Kent, mentioned the great appearance of Hop Aphis which had occurred in that district as follows :—

“ Our Hop-picking is virtually finished here (a few days earlier than usual), and now our orchards and hedges are infested with myriads of Hop Fly. It is generally supposed that they are the parents of a heavy attack of Aphis next spring; the Damson trees are full of them.” The Damsons were also reported as being in some cases so covered with “lice” that they were almost worthless.

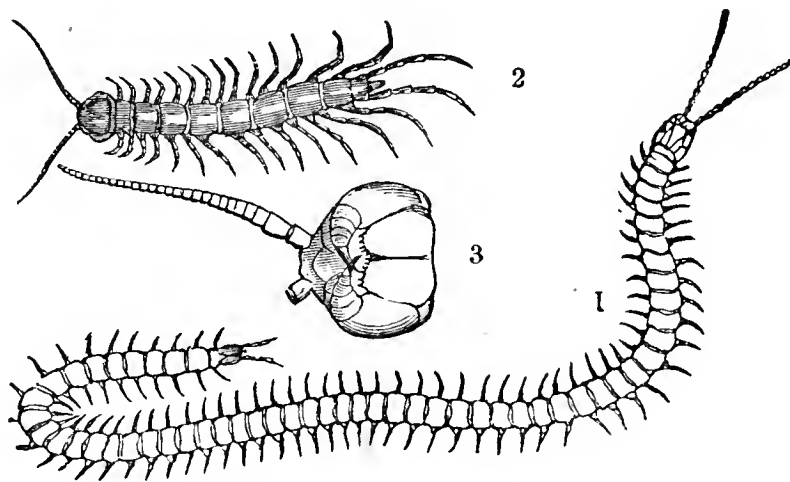
On Sept. 29th a packet of Hops injured by Aphides and black mould was forwarded to me from near Hereford.

It cannot, I think, be out of place, relatively to the fear expressed of early attack, to refer to the Stoke Edith experiments of 1884, in which it was found that in the instances of Hop-hills dressed in April with paraffin mixed with ashes, sawdust, or shoddy, the plants remained perfectly free from infection and perfectly clean up to May 26th (when attack came on the wing), whereas those in other parts of the Hop-yard were infested with wingless females and lice. The application did no harm either to the young bines pushing up through it, nor to the health of the plants; they did well throughout the summer.

If there is likely to be a bad attack in spring from the Hop Aphides that have wintered in the hills, or have hatched from eggs anywhere about the stocks, it certainly would save much loss if the amount of attack caused by lice creeping up the young bines from the hills early in the growth of the Hop could be prevented. The amount that arises afterwards towards the end of May or beginning of June from Hop Fly that comes on the wing cannot be prevented by the above measures, but it is lessened in the proportion of what in common circumstances would have spread from the bines which (where dressed as above) have

not been found to suffer from the first attack of *Aphis*, and therefore not to spread it. The proportion of paraffin used for the dressing was one quart, to one bushel of ashes or other dry material with which it was mixed.—(See pp. 52, 53 of 'Report on Injurious Insects,' by E. A. Ormerod. Simpkin & Marshall).

Long-horned Centipedes. *Geophilus longicornis*, Leach (? *Scolopendra electrica*, Linn.), (? *Geophilus subterraneus* of Murray's *Aptera*).



GEOPHILUS LONGICORNIS.

1, *Geophilus longicornis*; 2, *Lithobius forficatus*, "Thirty-foot"; 3, head of ditto, magnified.

There is no doubt as to the great mischief which is caused by the various kinds of millepedes, commonly known as *Julus* Worms or False Wireworms, but there are different opinions as to whether the long yellow centipedes (figured above at 1, greatly magnified) do harm or not. They are often to be found under stems, or pieces of wood, in gardens, and are distinguishable at a glance by their ochrey colour, the multitude of legs, and their habit of twisting in every direction when disturbed. When full-grown they are about two inches long, and the kind known as the Long-horned Centipede, which differs little, if at all, from the *S. electrica*, has the power of exuding matter which gives a bright light much like that of the glow-worm in colour, but which can be freely dropped from the animal. I have seen it as a trace or in bright spots on paper in which one of the centipedes had been carried.

In regard to the food of these centipedes, Mr. A. Murray considered them to be only animal feeders. John Curtis mentions them as being animal feeders, but also that he had found them amongst Potatoes; and, further, that they subsist partly on succulent roots, ripe fruit, and decaying vegetable matter, only coming out at night, apparently in search of food (see Curtis's 'Farm Insects.'). Dr. E. L. Taschenberg notes that they are to be found "at the roots and

bulbs of various plants, as of Potatoes, Parsnips, Carrots," &c.; and that, according to Kirby's observations; they have been found destructive to the last-mentioned of the above roots.

The following notes sent me on the 20th of July by Mr. T. A. Ashton, of Temple Laugherne, Worcester, appear to point very strongly to the damage to his Hop-plant being caused by these centipedes, of which specimens were forwarded. It will be observed that the centipedes were found close to where the bine was gnawed, and where it was then fading; likewise that after the centipedes were driven away from the surface of the ground by wet that less damage occurred.

On July 20th Mr. Ashton mentioned that they had been making considerable havoc in his Hop-yard during the summer. They were only found in the old yards, and only in places there,—not generally distributed. The bine was gnawed off close to the crown, and the centipedes were found under the soil round the head of the stock, and in some instances in cracks in the stock itself. In no case were any of the centipedes to be found where the stock had been dead some time, as shown by the condition of the bine; all the specimens forwarded were found where the bine was fading, but not yet dead.

It was also mentioned that the places in the yards where the centipedes were all found were limited to where the Hops had suffered from wet. After the rain had fallen (July 13th) the centipedes went lower down in the ground, and less damage occurred.

I suggested that dressing the surface of the hills with ashes and paraffin might be of service, as being obnoxious to the centipedes,—and an application known by experiment on a good scale not to be injurious to the Hop-bine,—or that an application of "emulsion," as it is called in the United States (that is, of soft-soap and a little paraffin), applied as a watering, might be similarly useful; but Mr. Ashton did not think his own experience of mineral oil as a preventive satisfactory.

The following observations of Mr. Martin Burl, of Elsenham, Bishops Stortford, refer to damage to Vetches or Tares infested by some amount of true Wireworms, but also by a much larger amount of the *Geophilus*, mentioned above. On the 28th of April Mr. Martin Burl wrote as follows:—

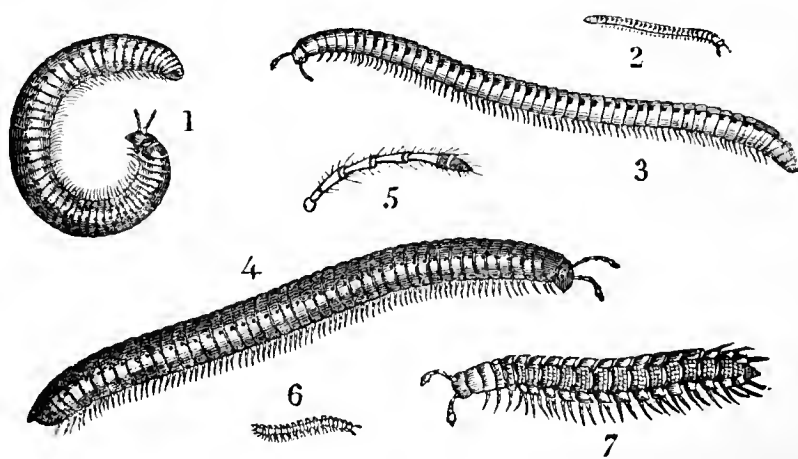
"Herewith I enclose specimens of insects, and would be glad to know if they would be the cause of my Vetches or Tares dying off, some few of which I also enclose; they were sown in the autumn and came up very well, but have been losing plant the last two months; and I am going to resow some three acres out of five, which is the extent of field. On digging over a piece to-day I find a very few of the ordinary wireworm, but a great number of the enclosed ('thousand legs,' as we should call them)."

A few days later some more specimens were forwarded, with a note that the millepedes (that is, the *Geophilus*) were by far the most numerous, and the following communication:—"I gave the field a dressing of 1 cwt. per acre of sulphate of ammonia about a month since, and have resown it with Tares to-day; it was cropped with Oats last year, and a good deal of long stubble was ploughed in, but no farmyard manure was applied."

Looking at the above observations, together with the notes previously given of the method of feeding of this kind of centipede, it does not seem open to doubt that they have a power of injuring crops, but at the same time they do not appear to exercise it often to a serious amount.

The history of long yellow *G. longicornis*, as given by Mr. Newport,* is that the female lays from thirty to forty eggs "in a little packet" in a cell which she forms for them in the earth, and does not leave them until the eggs hatch, which is in about a fortnight or three weeks. It is stated that during this time she remains in the cell with the eggs, incubating them, and constantly turning and attending to them.

From the above points it would appear that, where there is any great amount of centipedes, thorough stirring and turning the surface of the ground would be the best way to put an end to the attack, as they would thus be thrown out of their shelters in winter, and in the breeding season, when it is accepted as a fact that the female takes the enormous care mentioned above of the eggs, any operation which would scatter them abroad, where no shelter was given and no care taken, would save much increase.



JULIDÆ; POLYDESMUS.

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

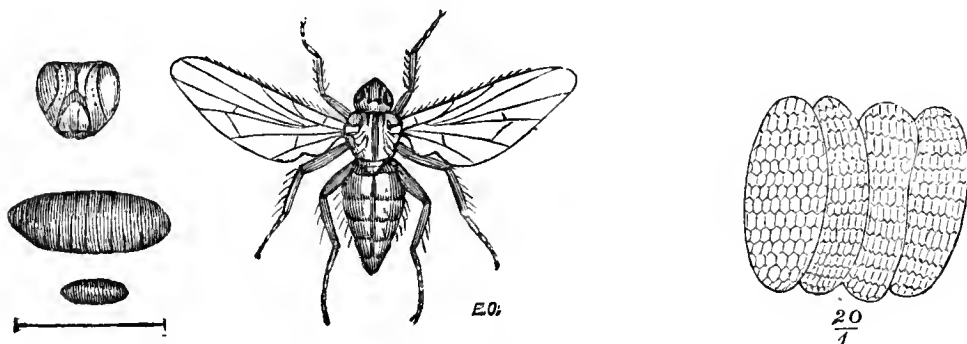
Snake Millepedes, or *Julidæ*, have again been noted as destructive, and in cases (such as one of those reported) where they are working

* Trans. Linn. Soc., vol. xix., p. 428.

havoc in very large country gardens, where the extent of ground allows a great deal of what may be called spare land, it is very difficult to remedy the evil. Where there is storage of decaying leaves, and all the miscellaneous matters which pass under the name of rubbish, on outlying bits of garden, there equally surely is a head-quarters for multiplication of millepedes, and a centre whence they will spread at leisure, as well as pass by carriage in compost to the neighbouring ground. For history and prevention see previous Reports.

MANGOLD.

Mangold Fly. *Anthomyia betæ*, Curtis.



ANTHOMYIA BETÆ.

Mangold Fly and pupa, mag. and nat. size; head and eggs, magnified.

The following note was sent me by Mr. John Page, of Yieldingtree, near Stourbridge, regarding a stimulating dressing which he had found useful in bringing Mangolds which were attacked by leaf-maggot satisfactorily through attack.

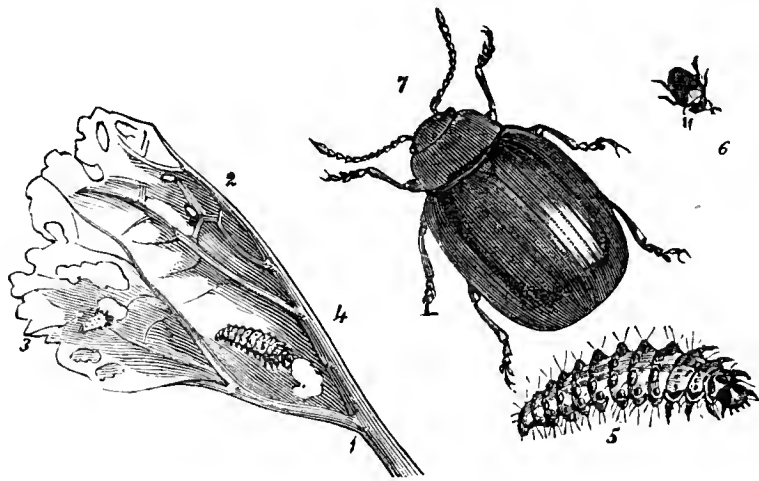
Mr. Page had forwarded me specimens of Mangold-leaves injured by the maggot, together with enquiries as to what treatment might be serviceable; and on Aug. 18th he reported further:—

“Referring to the attack of Mangold maggot, I am happy to say it passed off without materially injuring the crop. I applied a dressing of 1 cwt. of nitrate of soda, 3 cwt. salt, 2 cwt. kainite and soot, per acre, which forced the plants into active growth, and they are now a splendid crop.”

In attacks of this kind, where the crop perishes simply from exhaustion in consequence of the leafage being destroyed by the maggots faster than the growing powers of the plants can replace it, a dressing like the above, which will come into action with the first shower and cause immediate growth, is sure to be of use.

MUSTARD.

Mustard Beetles. *Phædon betulæ*, Linn.; Turnip Flea-beetle, *Haltica* (*Phyllotreta*) *undulata*, Kuts.; Turnip-flower Beetle, *Meligethes æneus*, Fab.; and Turnip-seed Weevil, *Ceutorhynchus assimilis*, Payk.



MUSTARD BEETLE.

Mustard Beetle and maggot, nat. size and magnified.

The replies with which I have been favoured by some of our leading Mustard growers to the circulars issued by the Royal Agricultural Society, requesting observations regarding the habits of the Mustard Beetle, and measures found useful for prevention of its ravages, contain much serviceable information, especially as to the great variety of places in which the Mustard Beetles, which start the spring attack, spend the preceding winter, and also as to means of lessening amount of attack (and amount of injury from what may occur) by regular agricultural treatment.

Also, by means of specimens with which I have been favoured we have been enabled to make out clearly which of the various maggots that are to be found on the Mustard-plant is that of the true Mustard Beetle, and thus to trace its history with certainty, which, as far as I am aware, had not previously been done.

Further, the fact has been very clearly brought to light that the mischief ascribed to what is commonly known as the Mustard Beetle is by no means entirely caused by this one kind. It is largely shared, when the plant is in its first leaves, by the Turnip Flea-beetle or Fly, and next, when the plant is knotting for flower, by the Turnip-flower Beetle, or *Meligethes æneus*. Other kinds of beetles are also present, as the small dark grey Turnip-seed Weevil (the *Ceutorhynchus assimilis*), and do more or less damage; but the two sorts first mentioned are present frequently and to a serious extent, and the *Meligethes*, which are not at all unlike the true Mustard Beetle, excepting in being

smaller and of a duller or more blackish green, are often mistaken for it.

These points are of use practically, as they place some of the methods by which the Mustard crop is to be saved from injury on quite a new footing. Turnip Flea-beetle at least can be kept down by methods of cultivation and treatment which are well known, and applicable to Mustard as well as to Turnips, and thus the complete ruin of whole fields of Mustard in its first growth might be prevented. We have no knowledge, as yet, of how to destroy *Meligethes* when on the flowering heads; but the fact that this beetle also infests the flower-heads of Turnip, Rape, and Cabbage, and likewise of Charlock, may be turned to account, both in rotation of crops and likewise in care to exterminate weeds which would foster it.

In the following report I have first given the replies with which I have been favoured relating to the habits and means of prevention of ravage of the Mustard Beetle, which was the special subject of enquiry, and to these I have appended the life-histories and descriptions, with figures accompanying, of the four kinds of beetles mentioned above, of which three kinds infest the plant to a serious extent, and the fourth is found on it, and, judging by its habits on allied crops, probably injures the formed seed.*

Where attack comes from.

1.—Where do the beetles which start the spring attack shelter in the winter? As—down old Mustard-straw; in straw used for rough thatch, &c.; down pipes of reeds; or in rubbish generally? Also—are beetles brought in seed?

The following observations show that the beetles shelter for the winter in a great variety of localities, as crannies in walls, gate-posts, or old wood; under bark, in the earth of hedge-banks, and of drain-banks; in heaps of rubbish; amongst rough grass by marsh-ditches, and amongst reeds, and down the pipes of reeds. Also in the ends of the Mustard-stocks, and in the roots of the old Mustard-plants left on the land, and in rough shelters made of Mustard or other straw; and it is noted that, when sheltered in the Mustard-roots or stalks, or pipes of reeds, they appear to be quite uninjured by exposure to frost throughout the winter.—ED.

“The beetles lie dormant in the winter in Mustard-stalks and reeds, and in all kinds of rubbish, and sometimes in the crevices of old woods.”—ALFRED FULLER.

* As it is necessary, in order to keep the series of subjects unbroken, to distribute the various portions of the contributors' reports under the headings of the enquiries to which each paragraph is a reply, I have appended the name of the sender to each of the communications, and likewise given it in the list of contributors.

“They shelter in the crevices of gate-posts, farm-buildings, &c., in the rough grass which grows on the edges of marsh-ditches, and in haulm walls, whether made of Mustard or any other straw. I found a great many last winter in the root-ends of the Mustard-stubble, a good part of which is left on the land when the crop is cleared, and may be found lying on the top all the following winter in the young Wheat. I have found as many as twelve beetles in one of these roots; they seem quite indifferent to frost, for, though when you open the stalk they seem dead, they soon begin to move. Many in these stalks, lying on the top of the land, must have been exposed to all the frosts of last winter.”—ERNEST SMITH.

“I have found them in drain-banks, when digging during the sharp frost; also in crevices or cracks in a gate-post.”—RICHARD H. SEARS.

“If the spring is warm they generally come in the beginning of May, or rather beetles then begin to attack the Mustard-plant, but probably not the *Phædon betulæ*. There are several kinds of insects which do great injury to Mustard during the different stages of its growth, up to the time it gets into flower. After the flowering-time the ravages of the *Phædon betulæ* are become more perceptible. There is a difference of opinion as to how and where they pass the winter. They have been found between the bark and wood of old decayed trees, in the cracks of gates, posts, and rails, in dyke-banks, hedge-bottoms, among reeds, in heaps of rubbish, stalks, &c., when left on the land,—in anything that will hide them warm and dry. A correspondent writes he has found them in all the above places, and has seen them out when the sun has been warm in winter.”—SAMUEL EGAN.

“I think the majority are to be found in the earth at the bottom of the hedgerows surrounding the field in which a crop of Brown Mustard has been grown.”—WM. ABBOTT.

“I believe these beetles during the winter months get in any reeds by the side of ditches, but what they feed on until spring I cannot say; but at the spring you may find them on any kind of Charlock or pieces of Mustard that are growing anywhere about.”—JOHN TIBBETTS.

“This insect will live through the most severe winter in the pipe of the reeds and rushes in ditches and drains. Two or three years since they were so numerous that many acres of nearly-ripe seed were burnt in the fields to destroy the beetle, but this was not effective, as they drop before the flame and bury themselves in the soil.”—C. CASWELL, Peterborough, 1883.

“In the ends of old stocks which are left on the land after the stocks are raked up and burnt; also on the ditch-banks in the long

grass or in the earth, they will live in the reed till the spring."—
CHARLES CLAY HARVEY.

ARE BEETLES BROUGHT IN SEED ?

The replies mention that they are to be found in seed after threshing, and have been seen alive in seed two years after threshing, but have rarely been observed to be brought with the seed.—ED.

"They are frequently found in the seed when freshly threshed, but do not appear to remain long afterwards."—ALFRED FULLER.

"I do not think they are brought in seed."—RICHARD H. SEARS.

"They are rarely brought with the seed."—SAMUEL EGAN.

"I have no personal knowledge that they are brought with the seed. 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."—ERNEST SMITH.

"I have never seen beetles in the seed, nor do I think they are brought there even the shape of eggs."—WM. ABBOTT.

"We have found the beetles alive in sacks of the seed for two years after it has been threshed."—C. CASWELL.

Weeds and Crops attacked.

2.—Upon what weeds or crops do the beetles feed till the Mustard is ready for them? As—Charlock, and the like; or brook-lime, and other weeds found by ditches?

"Cress, Charlock, Kohl Rabi, Cabbage, and other things of same nature and constitution."—ALFRED FULLER.

"My opinion is that they will eat White Mustard before anything else, then garden Cabbage and Horse-radish. Although there is abundance of Brown Mustard and Charlock growing near where the beetles were very numerous last year, I have only seen one or two on these plants at present."—ERNEST SMITH (June 26th, 1886).

* "I am not aware of any plant they feed on earlier than the Mustard. Charlock comes about the same time as early-sown seed. We have had Mustard growing, or at least green, all through mild winters, but we have not seen it eaten by beetles before the spring—April or May. Beetles appear as soon as the Mustard gets in leaf: the first have two light drab stripes down the body; others follow. It is the beetles which do the mischief: there are no grubs early in the season perceptible to the naked eye. In the beginning of May they

* This note refers to appearance of beetles generally (that is, not only of the *Phædon betulæ*) on Mustard. The striped beetles referred to are Turnip Flea-beetles, of which the attacks to Mustard are sometimes very severe.

will attack the leaf when old and strong (flavoured), then the stalk, working up to the pods (these they bark, the seed dries up, and drops worthless).”—SAMUEL EGAN.

“They appear to feed on all strong-tasted plants. For the last week they have been crawling out of my marsh of Mustard, have got into my garden (which joins it), and are now feeding off my Broccoli, and other species of the Cabbage; also Horse-radish, Nasturtiums, &c.”—C. C. HARVEY.

Means of preventing Attack, or of lessening the amount by Agricultural Measures.

3.—Dates of sowing; methods of cultivation and of preparation of the land found to answer in pushing the plant-growth on past harm from common amount of attack?

The following notes refer chiefly to the dates of sowing found to answer best in various localities and circumstances; to soil suitable for Mustard growing, and to details of thorough cultivation; liberal manuring; and other points adapted to favour healthy and free growth:—

“In Cambridgeshire, February to March; in Lincolnshire, March to April. I have this year sown some as an experiment in May, and it is going on well; but I prefer March sowings. The land should be in very good heart (newly broken-up land is undoubtedly best); it should be well-manured in the winter, well-worked and rolled down until solid before the seed is drilled, and again rolled after the drill. The seed should be drilled with superphosphate—if with a water-drill, so much the better.”—WM. ABBOTT.

“We generally sow Mustard from the 5th to the 15th of March, on land which was fallowed all the previous summer, and plentifully manured. By the end of March, in a fairly growing season, the young plants have stems as large as that of a clay-pipe; they are then singled out, allowing about a foot or fifteen inches between each. In the two years that I have known the beetle it has not begun to attack the plant before this time.”—ERNEST SMITH.

* “First week in March on summer fallow, well-mucked and scarified, and harrowed in.”—C. E. HARVEY.

“But my opinion in growing Mustard-seed is to put it in the ground as early in the spring as one dare for it not to be hurt from frost (say the latter part of February or beginning of March), and then the seed gets too forward before the beetle lays the eggs and becomes the maggot.”—JOHN TIBBETTS.

“We sow Mustard from March 20th to April 6th. If sown too early it is the more liable to injury from insects and frosts. Make the

* Mr. Harvey’s note refers to White Mustard.—ED.

land firm by rolling, deposit the seed just below the surface ; it comes up sooner.”—SAMUEL EGAN.

“ This year I have sown Mustard as early as the 2nd of April, on a nice fine loamy soil : it came up well, and grew very rapidly. When about 15 to 18 inches high it began knotting for flower (a farmer’s expression), I noticed the heads smothered with tiny beetles* (the Mustard Beetle). I should have sown about twenty bushels of soot per acre if I had had it by me, but on the 1st of June we had a very heavy thunderstorm, with some hail, after which I did not notice many beetles. It is now a fine piece of Mustard, nearly fit to cut, although the tops of the stalks for about 3 to 5 in. have no seed-pods on. I sowed 2½ cwt. superphosphate of lime per acre, drilled with the seed.”
—RICHARD H. SEARS.

“ The soil upon which Mustard is sown is the black peat or fen, which produce very fine crops when not injured by beetles. The early crops (sown, say, late in March or early in April) are generally best, but no manure or preparation of the land appears to have any effect upon the ravages of beetles.”—ALFRED FULLER.

On application to Mr. Jaques, of Howden, to whom I had been especially referred as a successful Mustard-grower, he mentioned that, although he had been a Mustard-grower for several years, he had hitherto escaped any attack from the Mustard Beetle, and favoured me, on further request, with the following details :—

“ The soil is known as ‘warp,’ and is artificially made by conveying the muddy waters of the Humber (and securing the alluvial deposit) on the original surface. I have latterly grown about forty acres per annum, about half of which was summer fallowed in the previous year, and dressed with farmyard manure in the ordinary way. The other half has usually been taken after Wheat on land in good manorial condition (this year, for instance, on land that was Clover and grass for seven years, then Potatoes 1884, and Wheat 1885 ; both crops heavy). As soon as the Wheat last year was harvested the land was twice steam cultivated ; then left until February, when it was ploughed over ; then left until the middle of April, when it was well-harrowed and drilled 16 in. apart with about 6 lbs. of White Mustard seed per acre. It is now coming into flower, and looking very well for so ungenial a season. When I have thought it necessary I have drilled 4 to 5 cwt. superphosphate or dissolved bones to push on the plant in its early stages. This year the weather and the soil were so cold in these parts that the plant germinated slowly, and made little progress for some time afterwards. Considerable breadths, I hear,

* The beetles sent accompanying were specimens of *Meligethes aeneus*, the Turnip-flower Beetle, of which account is given separately.

were ploughed up and resown in Holderness. Whether this was owing to the low temperature or the beetle I do not know."—THOMAS G. JAQUES (June 15th, 1886).

"I will just go over the best method for producing a crop of White Mustard-seed. First, make a clean *summer* fallow. Manure it with a large quantity of *unrotted* farmyard or stable manure: set it up in *four-yard* lands: plough in deeply: water-furrow and grip the field, as though for Wheat: leave it until the spring frosts are *well over* and the land dry enough to carry the horses without treading. Then harrow with sharp-tined light harrows. The fine winter mould gives an excellent seed-bed. Drill in the seed,—clean bright seed,—not too deep (say one inch only): cover with seed-harrows, without rolling. Four pounds of good seed should be sufficient, if it is a satisfactory tith. If Charlock or other objectionable weeds should appear, it will be well to clean them out with the hoe: if the plants are too thick, set them out with a four-inch hoe. Cut with a self-binder. Stack in wide stacks on account of linnets, or thatch down the sides. Thrash in March, when the days and nights are equal. And, if you have managed your apparatus satisfactorily, and have been fortunate in the season, you may send into the barn *five* quarters per acre,—five is possible,—I have thrashed *four and a-half*."—RALPH LOWE.

"I do not see my way to any efficacious remedy or preventive. I believe that early sowing and likewise manuring give the plants the best chance of escaping serious damage; but nothing can save a crop of White Mustard where once it is attacked after the seed-vessels are formed and before the seed is fully ripe."—W. C. LITTLE.

The following observations refer mainly to checking attack in infested districts by discontinuance of growth of Mustard for a time, and thus fairly starving out the beetle:—

"The only thing to be done when a farm becomes infested with the pest is to discontinue the growth of Mustard for a few years. This has been found to answer. Though the insects can live on other plants, they certainly diminish in numbers, and almost entirely disappear in the course of two or three years if there is no Mustard in the immediate neighbourhood. Burning the straw and chaff is, I think, desirable whenever the insects are numerous. You see I have spoken of the beetles as if these were only one kind of insect-enemy, but I have no doubt you are right in charging the Turnip Flea-beetles, and also the flower-beetles. Still, *the* beetle, *Phædon betulæ*, is the arch enemy, I think."—WILLIAM C. LITTLE.

"I have not heard of any effectual remedy. I tried to kill the beetles when the plants were not very high by rolling and cross-killing, but they did not mind it in the least. I also had men to go

in amongst the crop with tin mugs to shake every stem on which a beetle was seen, and so catch them. This was very expensive and unsatisfactory. I believe the only remedy is to leave off growing the Mustard a year or two, and so starve it out. If the beetle will really take Brown Mustard as a substitute for White, it will be difficult to do this in a neighbourhood like ours, where large quantities of Brown Mustard grow spontaneously."—ERNEST SMITH.

"As at present informed, I do not think there is any preventive but to leave off growing Mustard for a time. . . . Some few years back it used to be grown rather largely in this neighbourhood, but through the ravages of the beetle it could not be profitable; but this last year or so it has been grown again, and the beetles have not damaged it to a great extent."—WM. WILES GREEN.

"We have grown White Mustard for many years, but, through the entire destruction of the crop from the ravages of the Mustard Beetle, were obliged to discontinue it for some years."—RICHARD H. SEARS.

"The idea prevailing amongst those who have suffered very much from the ravages of the beetle is that nothing will destroy them, excepting it is the combined action of farmers not to grow any kind of food suitable for them."—ALFRED FULLER.

4.—What manures have been found serviceable? Is gas-lime used? Superphosphate of lime and artificial manures advised. Gas-lime not found to keep off attack.

"I have used Proctor and Ryland's special Mustard manure very successfully, the object being to promote healthy and rapid growth out of the way of insects. Artificial manures are necessary to secure a crop on old broken-up land. I was shown a crop the other day on part of which none was used, owing to a heavy dressing of farmyard manure having been applied. This was not half the value of the rest of the field."—SAMUEL EGAN.

"Besides superphosphate any rich manure is useful. I have not found gas-lime to be of much use."—WM. ABBOTT.

"Superphosphate of lime and dissolved bones have been found most serviceable. I have tried nitrate of soda without any good results. I am now applying gas-lime, but have not hitherto tried its effects." With regard to method of application it was noted:—

"The gas-lime was too adhesive to distribute evenly, so it was carefully mixed with sufficient fine dry ashes to make it powdery; it was then sown early in the morning, in the hope that it would adhere to the leaves, as it would appear to me to be of very little value if thrown upon the ground." (Further on Mr. Fuller mentioned):—

"I have been waiting to see how the Mustard Beetle developed before writing you again. This evening I have been to the field upon

which the gas-lime was distributed. There has not been a large quantity of beetle upon this field, but there will, I fear, be sufficient maggot to destroy the crop. Maggots alive and very voracious on fresh Mustard."—ALFRED FULLER, Esq., Ramsey, Huntingdonshire, July 10th, 1886.

Measures for Destroying Grubs or Beetles.

5.—Is there any kind of treatment found useful in getting rid of the grubs, such as dressing with lime or other applications when the dew is on? Or are any measures of service when the grubs go down into the soil for their change, such as hand- or horse-hoeing which would throw the chrysalids out, or lay them open to such birds as may eat them? Information would be particularly desirable as to any methods of destroying the beetles on the plants (if any such are known), or of checking progress when advancing in bodies. Notes as to checking progress by fire, or by making a trench in front of the advance and killing the beetles in it, or by any other means would be very acceptable.

The following observations refer to dressing *not* being found of service in getting rid of the grub. Ploughing in the crop at once when failing under beetle attack is noted as a means of saving further infection by burying down the eggs, which would otherwise have started a new brood, or by killing the insects which would have migrated elsewhere. In reply to the enquiry as to means of stopping the migration of the beetles in large bodies, observations are given of the practice of burning straw in front of the advance being often, though not always, serviceable, and of the use of tar filled along a shallow trench being also serviceable for the same purpose.—ED.

UNSERVICEABLENESS OF DRESSINGS; SERVICEABLENESS OF PLOUGHING IN CROPS INJURED PAST POWER OF RECOVERY.

“I do not know of any dressing that will stop the beetle when it has got to work.”—W. ABBOTT.

“I have sifted over the plants, lime, soot, sulphur, and sprinkled Jey's fluid and rock-oil, but with no effect. I do not know any birds that will eat them, or any way to kill them.”—C. C. HARVEY.

“Many things have been tried to destroy them or stop their ravages,—soot, salt, sulphur, lime, and carbolic acid,—and all without effect, so far as I am aware. The carbolic acid only killed about 10 per cent. of the beetles, although quite strong enough to kill the plants. . . . When the Mustard is dead, or ripe, the beetles leave it for other green crops; Rape, Turnip, or the like, they appear to leave in

a body; I have seen hundreds on a space but a few inches square. On one occasion they attacked a piece of Cole rather late in the season. The owner ploughed it up deep so far as he found beetles, and rolled it down with a heavy roller. By that means he says he saved his crop."—W. EGAN.

"Last year I had one marsh, which, about the second week in April, they commenced their attack upon in such quantities that they appeared to advance in a straight line and positively clear the ground as they went. The plant at this time was about four inches high. I saw that it was no good trying to save the crops, and on May 4th ploughed the marsh (29 acres) up and sowed it with Oats. I think this was the means of destroying an immense quantity of beetles, as all the under part of the leaves of the Mustard was covered with eggs, which, if the plant had been allowed to stand, would undoubtedly have been hatched out; when the leaves wilted the eggs perished."—ERNEST SMITH.

USE OF TAR.

"I have just made an unpleasant discovery that 39 acres of Turnip and Mangel are infested with the blue beetle, which appeared on my Mustard, disappeared, and suddenly reappeared on the Mangel; they seem to pass on to the Turnip after rapidly devouring these. We tried quicklime, dry lime, and Condy's fluid; but to no purpose. The headlands, roads, and footpaths are covered; there are millions. The Chase, leading to my house, is crawling; they travel from the Mustard field. Now the Mustard is cut they seem to have abandoned it for the opposite side of the Mangel and Turnip. I am working a shallow trench and filling it with cold tar, and I find they get in and cannot extricate themselves."—Per favour of Messrs. CARTER & Co., Holborn.

NOTES AS TO CHECKING PROGRESS BY FIRE.

"I have heard of straw being burnt in front of their line of march when the wind lay right for blowing the smoke over them. By persevering, this plan has proved partially successful; they retreated before the heat and smoke."—SAMUEL EGAN.

"Some years ago I had a piece of Cole, or Rape-seed (sown in July), next to a White Mustard field. The beetles went over the ditch and cleared every particle of green Cole-seed, just as far as the Mustard field extended. I took two loads of short and damp straw and spread it in a line just before them (about 150 yards long), and set fire to it. It prevented them going any farther."—RICHARD H. SEARS.

"I have heard of the method of burning damp straw in dull heavy weather, when the smoke will keep low on the ground, the fire being arranged so that the wind takes the smoke in the right direction, *i. e.*, on to the plants."—WM. ABBOTT.

“ Burning straw to cut off the beetles has been tried, but they burrow in the land and quickly reappear, and accumulate so rapidly that killing a few thousands is not noticed.”—ALFRED FULLER.

“ I do not know of any remedies, or rather preventive steps, being taken, except that sometimes when an army of beetles has been seen on its passage into or across a field of young Rape, Kohl Rabi, or some similar crop, stubble or straw has been burnt, and has been effectual.”—WILLIAM C. LITTLE.

“ From a Mustard field they troop off to any neighbouring field where plants of the same tribe are to be found. They will completely devour a field of Rape if it is in a young stage, and a crop of Kohl Rabi, with bulbs as big as an orange, may sometimes be seen with the leaves bitten off by these insects, nothing but the rib of the leaf being left. At this period they seem to make little use of their wings. I have stopped their progress completely by burning damp straw in a gateway through which they were passing, but previously they fly vigorously. No attempts appear to be made to check the pest, excepting the above plan of occasionally burning straw or stubble to arrest their progress when moving from one crop to another, or burning the straw or haulm after the crop has been reaped, by which means the great numbers of beetles which had sheltered in the hollow stems of the plant are destroyed.”*—WILLIAM C. LITTLE, 1883.

DRAGGING WITH ELDER BOUGHS.

“ Brushing with elder boughs fixed in a hurdle and drawn by a horse over the young plants is useful, as also is hoeing and rolling. These measures act as a check to the work of the beetles. Probably the birds destroy the chrysalids when drawn up by the hoe; young chickens and ducks, too, will eat the insects.”—W. ABBOTT.

General Information.

6.—As to effects of weather; to the rotation of crops; to the neighbourhood of previously infested land; in fact as to any of the points which are known to Mustard growers as bearing on the subject, would all be of service. Any observations as to whether wireworm was found in Mustard fields, or attacked Wheat or other crops succeeding Mustard, would also be of much interest.

* This observation, with which I was favoured by Mr. W. C. Little in 1883, is particularly worth consideration, as it points out the possibility of destroying the migrating bodies whilst passing through a confined space; and likewise mentions burning the Mustard straw after the crop has been reaped. Where this is carried out, spring attack from the beetles which had wintered either in the stumps or the old roots, as mentioned at p. 59, would effectually be prevented.—ED.

“ We grew several acres, 30 to 40, of White Mustard annually (before we were troubled with the beetle) up to about ten years ago. It then spoilt the crop completely, so that we left off growing. I have this year tried a piece again.”—RICHARD H. SEARS.

“ No doubt warm showery weather, from the time of drilling until the plants are in flower, is the best of all remedies against the attacks of the beetle. I have seen crops attacked growing miles from the nearest land whereon Mustard was grown the previous season. As to rotation of crops, I have found Mustard succeed well after Clover or even a straw crop, if a large dressing of manure has been applied on the stubbles; but I have had poor crops after Turnips eaten on the land.”—WM. ABBOTT.

“ It appears to me that the rotation of crops does not make much difference, unless you sow such crops as will provide food for the beetles. Whenever they appear in any part they quickly spread to the neighbourhood, going a long distance for suitable food.”—ALFRED FULLER.

“ I first recollect hearing of the ravages of the Mustard beetle in Lincolnshire about twenty-five or thirty years ago. A farmer spoke of them as the Mustard ‘Clock,’—I will not be answerable for the correct spelling of the word,—a kind of beetle that injured the Mustard plant if grown more than two years consecutively on the same land or adjoining fields. I heard little more of them until a few years ago, when they made sad havoc in the fen districts of Cambridge-shire, Whittlesea, March, and Ely; they came in swarms, a perfect pest. When the Mustard was done they took the Cabbage and Turnip plants among the Mangels, completely destroying them. I have counted over 500 shaken from one Cabbage. That season they destroyed every crop of the kind in their track,—Turnips, Rape, Cabbage, and Mustard. We have suffered very little from them since; we have not many this year, at present. From observation I find there are certainly more than one kind of beetle which injure the Mustard plant. I have forwarded you at least three distinct kinds, I believe. Some seasons we scarcely hear of any injury being done by them. On pieces of land that have not been Mustard before or for some years we rarely find them; lands that have been Mustard two years or more invariably suffer most. The leaves enclosed are very much perforated; they came from near Long Sutton, in Lincolnshire, while in this neighbourhood we have heard of but little injury being done at present.”—SAMUEL EGAN, Wyde House, Thorney, Peterborough, June 26, 1886.

“ I have been in the habit of growing upwards of 100 acres of Mustard every year until this, when I have none at all; most of my neighbours have done the same. We are surprised that the

one bold man who is growing it this year, in close proximity to fields where the crop last year was almost spoiled by the beetle, has not had his entirely eaten up, and they do not seem to have harmed it at present. On Foulness Island, where last year there were 350 acres of seed there are now only 26 acres, and yet, strange to say, this small area is not much affected by the beetle; there are but a few specimens to be found in it, and they seem to have done no harm *at present*. In my opinion, at certain times they fly in large quantities with the wind; a field of seed may be free from beetles one day and covered with them the next.”—ERNEST SMITH.

The following notes show sudden appearance of the beetle:—

“I was on Foulness yesterday, and Mr. C. C. Harvey showed me a roadway running alongside of the only (in consequence of the beetle) field of Mustard on the island. It was covered with beetles, which were leaving the Mustard in search of pastures new. *They only showed themselves ten days ago*, and in that time have done much damage. I enclose a few stalks to show their work. As soon as the stalks become hard, I imagine they leave it and go elsewhere. I am told they are spreading in other parts of Essex.”—ARTHUR HARRINGTON.

“I left the neighbourhood where Mustard-seed is grown in 1872, when the beetle was not known; and hearing the damage it did last season, and knowing that a great many growers did not intend growing any more, I thought seed might be scarce and perhaps dear, so was tempted to sow 25 acres here, which is at least 10 miles from the nearest point of the mustard neighbourhood, and so thought I should be safe from the insect. I have been on the look-out for the beetle for 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. MEESOM, Battles Bridge, Essex.

Wireworm.

7.—Whether wireworm is found in Mustard fields, or attacks Wheat, or other crops succeeding Mustard?

From the replies noted below it appears that Mustard is frequently of use in getting rid of wireworms in the land, or in lessening the amount of their ravages, but that it is not exempt from wireworm attack; and where wireworms are present in very great numbers that it may suffer as severely as other crops.

“I have not seen or heard of wireworms attacking succeeding crops of Wheat or other cereals.”—ALFRED FULLER.

“ I believe it to be a good system on land infested with wireworm to grow White Mustard. In my experience on a certain piece of land several crops failed through wireworm ; we sowed White Mustard one year and got a good crop of Wheat the next.”—RICHARD H. SEARS.

“ Mustard is a very excellent preparation for Wheat, if not the best. Mustard has a tendency to destroy or prevent the ravages of the wireworm. A field well-known to the writer was infested with wireworm some years ago ; it has now been Mustard several times. Wireworms are rarely met with ; the Wheat crops lately have not suffered in the slightest degree.”—SAMUEL EGAN.

“ Mr. Tallant, of Raucby Grange, in 1827 introduced the practice of sowing White Mustard upon land infested with wireworm. It has been considered to be a specific from that time.”—RALPH LOWE.

“ I have not noticed wireworms in Mustard fields.”—WM. ABBOTT.

“ The wireworm seldom attacks any crops grown after Mustard, but does most mischief after Rye-grass, Tares, and sometimes Turnips and Mangolds ; but have noticed that there are certain lands on my farms which are continually eaten up by wireworm, the same spot in the same field, year after year.”—THOMAS P. BRAND.

“ I think it is a common thing to find Mustard attacked by wireworm, but only on land which is subject to the pest. I have had a marsh of Mustard destroyed by wireworm, and when ploughed and sown with Oats met the same fate.”—ERNEST SMITH.

“ In 1885 I had a piece of 4 acres of Potatoes very badly infested with wireworm, so much so as seriously to interfere with the quality and sale of the produce of the crop. *Mustard* not having been grown upon this field for very many years, and inclining to a somewhat popular belief that such crop acted as a scourge to the insect in question, I sowed the field (drilling broadcast) with one peck per acre of seed. Although well done, and the land in perfect tilth (3 cwts. per acre of guano harrowed in before sowing), the seed did not make its appearance ; and on examination I found that so soon as the germ showed signs of vitality the wireworm ate its way through it. Thus the chance of a Mustard crop was entirely destroyed. Certainly 95 per cent.* of the seed was thus consumed. I may add that samples of this Mustard were sown under other circumstances, and showed great growing capabilities.—A. BANNESTER.

* As confusion occasionally arises between presence of the true wireworm, and of millepedes or “ false wireworms,” which are also very injurious to Potatoes, I think it desirable to note that the observer is perfectly aware of the distinctions between the two kinds, and that the above observation refers certainly to the true wireworm (that is, to the larva of the click-beetle).—ED.

Descriptions and notes of various kinds of beetles injurious to the Mustard crop. *Phædon betulæ*, Linn. ; Mustard Beetle (see fig., p. 58).

The beetle, which is especially known as *the* Mustard Beetle, is the *Phædon betulæ*, Linn., formerly the *Chrysomela betulæ* (see fig., natural size and magnified); it is oblong-oval, hardly the sixth of an inch in length, of a full blue or greenish colour above, so brightly shining as to be of almost glassy lustre. The leg, horns, and body beneath black. The thorax (or fore body) evenly punctured, the wing-cases with lines of punctures, and the spaces between these punctured also.

These beetles pass the winter in a torpid state, in any convenient shelter near the fields where they have been in autumn. In spring they become active again, and, spreading to whatever food-plant may be near, they lay their small eggs and die. The grubs which hatch from these eggs are of the shape figured, and are from about three-sixteenths to 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 caudal foot or proleg 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.*

These voracious grubs devour broadcast until, when full-fed, they go down into the ground to turn to chrysalids. In this state they are said to remain about fourteen days, and from these chrysalids the summer brood of beetles comes out, which often spreads devastation over the Mustard crop, which is then in an advanced state.

This is the history of the true Mustard Beetle, but the observations of the past season have shown that harm is caused to Mustard by various kinds of Turnip Flea-beetle, or Turnip Fly, as it is commonly called. The following observations refer to this attack:—

“The Turnip Fly is sometimes a great trouble by eating the plant when it first comes up.”—ERNEST SMITH.

“I send you another specimen of the pest, which I believe is the real cause of the mischief, for I have to-day ‘caught him in the act.’ . . . They are very difficult to catch, as they hop off the Mustard so very briskly, and the one in the quill is the only fellow I could get there. . . . I can find no Mustard Beetle in the field, and my belief is thereby strengthened that the ‘flea’ now sent is the cause of all the mischief. I enclose a little bit of the Mustard-leaf: scarcely a plant can be seen of the original sowing.”—W. ABBOTT.

The specimen sent was of one of the yellow-striped flea-beetles known as *Phyllotreta undulata*.

* The description given by John Curtis, in his ‘Farm Insects,’ of a larva which he considered would turn out to be that of the Mustard Beetle, precisely agrees with those from which I developed the beetle last summer.—ED.

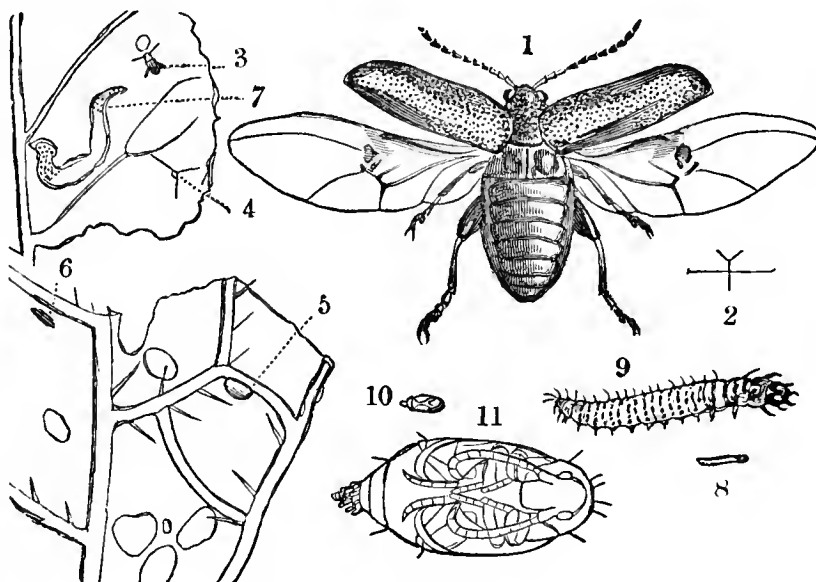
“I send you specimens of insects which are now apparently destroying my Mustard on that part of the field where the seed-bed was not properly prepared; they are not to be found elsewhere.”—

R. C. CATLING.

[Three distinct kinds of the beetles, commonly known as Flea-beetles, were sent accompanying.—ED.] Eight days later (that is, on the 16th of May) it was further reported that the beetles had greatly disappeared, *owing to the deluges of rain which had occurred*, and previously to this a dressing of liquid superphosphate had been applied.

The Flea-beetles are easily distinguishable from Mustard beetles by their tremendous leaping powers, and often by having a yellow stripe along their dark green or blackish wing-cases.

The accompanying figure shows the enlarged thighs, suitable for leaping with, which are one chief mark of this family of beetles, and also gives a general idea of their shape.



HALTICA NEMORUM, *Linn.*

Turnip Flea-beetle, eggs, maggot, and pupa; nat. size and mag.

The *P. undulata*, which I found on Mustard, differs from the kind figured above in having the shanks reddish yellow only at the base, whereas the shanks of *nemorum* are entirely reddish yellow; but the two kinds are very like each other, and very common.

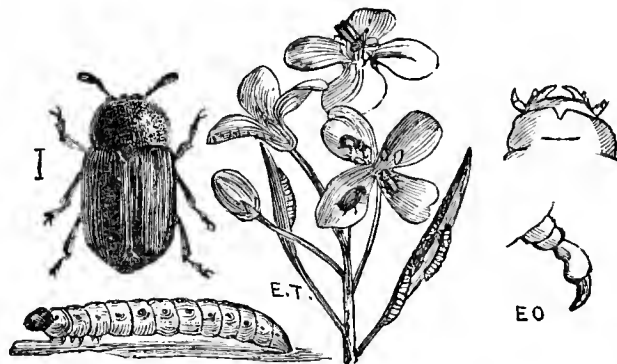
The habits of Turnip Fly, like those of Mustard Beetle, are to shelter during winter in any convenient place, and come out again in spring, and (as we know) attack the seed-leaves (and others, if tender) of Turnip, Cabbage, or allied plants; but Mustard is especially sought by it, as is shown by the practice in some places of mixing Mustard with Turnip seed to draw off the fly. The same methods of good cultivation and manuring, which are suitable for pushing on vigorous growth both of the Turnip and Mustard (and which are especially advised in the previous pages by good growers as a means of keeping it free of the Mustard Beetle), would be an important help against Flea-beetle; and a large part of the treatment advised by Turnip

growers in the Report of 1881 on this means of keeping down the pest would apply equally well to lessen its ravages on Mustard.*

Amongst the various details there given dusting the infested plants with lime or any mixture injurious to the beetles is particularly mentioned as serviceable, if applied when *the dew is on*, so that the beetles, having their leaping-legs clogged with the moisture, cannot get away, and the poisonous mixture adheres to them. Many sorts of mixtures will serve equally well, but as the following differs slightly in its ingredients from those previously mentioned, and the recipe was contributed during last season's Mustard observation, I insert it as follows:—

“To prevent the Turnip Beetle from destroying the Turnip seedlings, I find dusting them with a mixture of soot, lime, burnt soil and stick-ashes, or charcoal in dust, to be useful, with brimstone or petroleum to give it a strong smell. This to be used when the dew is on the seed-leaves, early in the morning or late at night after a shower will do. I have worked for hours, after the men have done work, spreading the dust with the hand, but have never had to regret it as lost time.”—J. W. FREEMAN.

Mr. Fisher Hobbs's mixture is still simpler, and has been well tried. This is one bushel of quicklime and one of gas-lime, six pounds of sulphur, and ten pounds of soot, mixed well and to a fine powder. This to be applied *when the dew is on*. The above amount is enough to dress two acres. The dressings may be applied by hand or by machine.



MELIGETHES AENEUS, *Fab.*

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

Next after the flea-beetles on the young leaves come the “Turnip-flower Beetles,” figured above, on the heads knotting up to flower. Last season's observations showed that these little beetles (which are only of the length marked at the left of the magnified figure) occur in great numbers.

On June 10th Mr. G. Moore, Secretary of the Wisbech Chamber of Agriculture, forwarded me a box containing a large number of them,

* See Turnip Fly. Report of Observations in 1881. By E. A. Ormerod. Simpkin & Marshall, Stationers' Hall Court, London. Price 6d.

“ now infesting a large field of Brown Mustard on the farm at Needham Hall ” (near Wisbech); “ I noticed them on Sunday evening in great numbers in the flower-knots of the plants, and I have during the past two or three days seen them in other fields on other farms.”—G. MOORE.*

On June 14th specimens were sent, shaken off the flowers of Mustard-plants near Peterborough; on June 26th specimens were sent from Wainfleet, Lincolnshire; and on July 27th I had again some of the same kind of beetle (*M. æneus*) sent on flowers taken from White Mustard at Manea, Cambs.; and I had an opportunity of seeing the *Meligethes* myself on both Brown and White Mustard flower at Coldham Hall, and Stags Holt, near Wisbech, in July.

These beetles are little more than the twelfth of an inch long, of the shape figured at p. 74, and of a deep greenish colour. The eggs are long, cylindrical, blunt at each end, and so transparent that the development of the maggot may be watched from the day after laying. Hatching takes place in four or five days. The maggot has a broad head, with sharp jaws, three pairs of legs, and also a proleg (at the end of the tail). When full-grown the maggots are yellowish white; earlier in their life they are usually somewhat spotted.

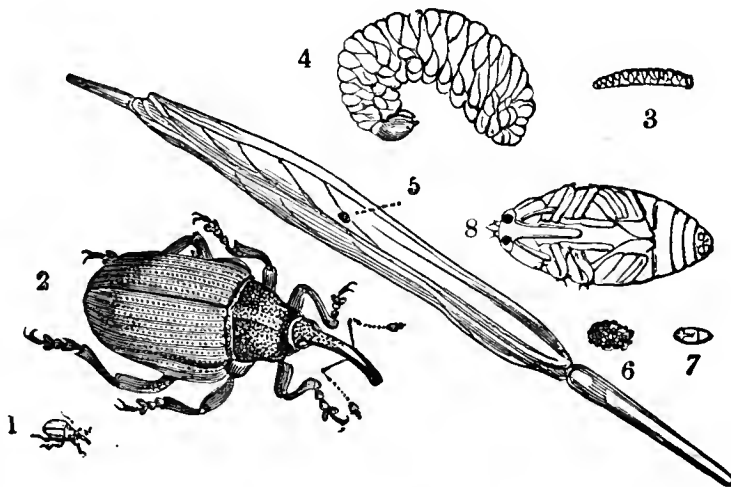
The method of life, as I observed it on various plants of the Cabbage kind, was as follows:—About the 6th of June *Meligethes* were to be found in great numbers in the blossoms apparently feeding entirely on the pollen (probably they had been about for some weeks previously); shortly afterwards eggs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

* As there are several kinds of *Meligethes* varying little from each other, I submitted some of the above specimens, for the sake of absolute certainty, to the thoroughly skilled examination of Mr. Oliver E. Janson, who reported that he found fifty specimens of the *M. æneus* and one of *M. picipes*.

† Life-history of *Meligethes*. By E. A. Ormerod, Ent. Monthly Mag., 1874.

The beetles shelter during the winter, and are stated by Dr. Taschenberg to come out from winter-quarters in April and to fly briskly about in bright sunshine.

The damage caused by these beetles does not seem open to any cure when they are on the blossoms, excepting the German method of shaking them off into any convenient vessel on dull shady days or early in the morning; but, though this is effective where it is possible to get at the plants, it is not applicable to a large Mustard field, and all that we know at present regarding means of lessening the amount of their presence appears to turn on rotation of crops and removal of winter shelter.



CEUTORHYNCHUS ASSIMILIS, Payk.

Beetle, maggot, and chrysalis, nat. size and magnified. Infested Turnip-pod.

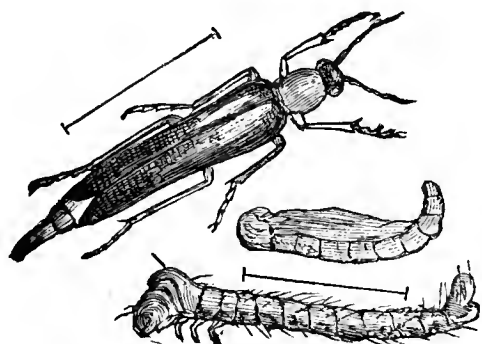
A fourth kind of beetle to be found on Mustard is the "Turnip-seed Weevil," figured above. This may be very easily known from the other three kinds by its dark greyish colour, and by its long slender curved proboscis. The maggot of this beetle feeds on the seeds of various plants of the Cabbage tribe, whilst these are still in the husk.

Specimens of the weevil were sent me, taken from Mustard near Peterborough; and Mr. Ernest Smith, writing from Southminster, Essex, mentioned:—"I have frequently seen the weevil you mention in the seed, but have hitherto regarded it as a harmless insect." We have not enough observations yet to know how much harm it does, but I have found seeds eaten out in samples of Mustard sent me, and should say that it would be well to know more about the extent of attack.

The list of contributors to the above Report is inserted on the page preceding the Index.

O A K.

The Dockyard Beetle. *Lymexylon navale*, Linn.



LYMEXYLON NAVALE.

Dockyard Beetle, maggot, and pupa; magnified figs., with lines showing nat. length (after figs. by Prof. Westwood).*

This beetle takes its name from the injury it causes to ship-timbers. It is stated to be common in the Oak forests of the North of Europe, and that it does not do great mischief in such localities, because it only attacks decaying trees, and not sound standing wood, but that felled timber, and especially ship-timbers, are badly perforated by its maggots.†

The injuries which were caused to dockyard timber long ago in Sweden by this attack are well known; since then Dr. Bernard Altum mentions similar injury occurring near the Adriatic Sea; and Prof. Westwood notes it as being occasionally so abundant in the dockyards of France as to cause considerable damage; also, in 1850, Professor Westwood mentioned‡ having received, in the month of June of that year, specimens of larvæ which he immediately recognised as of this beetle (*L. navale*), from a correspondent at Pembroke Dockyard. "They were found destroying the Italian Oak 'thick stuff' (the technical name for planks about four inches thick in store at that port). They were not seen when the wood arrived and was tested, but their ravages were becoming serious"; and the perfect insects were appearing by thousands in the Pembroke Dockyard in July.

It appears probable that this timber was in infested state, though not observed to be so, on arrival from Italy; but however that may be, up to the present time the *Lymexylon* has been a beetle rare in the extreme in this country, as an apparently true native; I am not aware that it was until last summer, when I received the following report of his own observations from Mr. Joseph Chappell, Chorlton-on-Medlock, Manchester, that notes have been given of it being found in large

* See 'Gardeners' Chronicle' for 1850, p. 677.

† 'Der Forst. Zoologie,' von Dr. Bernard Altum. Vol. III., Insecten.

‡ See 'Gardeners' Chronicle,' quoted above.

numbers in this country infesting living timber. Mr. Chappell mentions:—

“A few years since I found this dreadful pest in Dunham Park (Cheshire). I found *Lymexylon* at first at rest at the base of an Oak tree which had recently been cut down, and which had cracked slightly near the centre. On carefully examining it I perceived the ovipositor was insinuated into one of the cracks. I took four other specimens in the course of a week or fortnight, all of which were females.”

In the following season Mr. Chappell, with an entomological friend, cut them out of other trees, where they had infested the trunks in both the larva and imago state; these had been infested while still growing, and had recently been cut down. The insect was observed to run quickly on the trunks of the trees, and enter the perforations previously made by it almost before it could be secured without the captor being on the alert.

In the following season (the third year of observation) one was secured on the wing, and, following up this hint where to look for it, Mr. Chappell “found it freely on the wing, both male and female. It is a very high flyer. The perfect insects might be seen on the wing on hot sunny days, towering above the giant Oaks,—I should think about one hundred feet,—perhaps higher than the beautiful Purple Emperor Moth soars generally. It was only occasionally we could capture it by the use of a net on a long bamboo, and patiently waiting until it descends to lower regions.”

The beetle is of the shape figured at p. 77, and, as I have never met with the attack myself, I copy the description given by Professor Westwood* :—“The male is black, with the inner base of the elytra (wing-cases), legs, and abdomen dirty orange-coloured; the female is larger and brighter coloured, with the thorax reddish, the head, margin, and apex of the elytra and wings dusky black, the antennæ brownish black, and the legs pale fulvous.”

“The larva is a long, very thin, cylindrical, white, fleshy grub, like a worm, with a corneous head, the first segment of the body produced into a sort of hood over the head, three pairs of short-jointed legs, and the terminal segment of the body swollen.”†

With regard to the habits of this beetle, it appears, from the various observations, to attack the solid wood of old trees, or of felled timber, in which consequently the sap has ceased to be in movement. Dr. Bernard Altum notices it as occurring “on large old Oak-trunks, which are so far struck by decay that the bark has begun to loosen and fall away,” and that “it comes out of cracks of these trunks, and rests on stack or cord wood, and swarms from the beginning till the

* See ‘Gardeners’ Chronicle’ for 1850, p. 677.

† Id., p. 677.

middle of July, on warm days between two and four o'clock in the afternoons, with a heavy flight (or soaring) like that of the *Dermestes*.*

The state of things amongst the fine old Oaks at Dunham must be very similar to that described by Dr. Altum, as Mr. Chappell notes, "It is very probable that some of those giant Oaks in Dunham Park have had their existence terminated by it," for it is obvious that an Oak must have attained a very considerable age before the term "giant" can be applied to it.

The presence of this beetle must have been well established, as it will be noticed that the observations extend over three years, and the damage, by means of larval perforations, extended deep into the timber; for Mr. Chappell remarks that, accompanied by a friend, and both armed with tomahawks, they cut holes in the Oak twelve inches deep before they succeeded in finding the larvæ. These were "very long and slender, with the first segment after the head dilated, and the terminal segment produced into an obtuse lobe" (as figured and described by Prof. Westwood). Male beetles also were found at the same depth.

In regard to measures of prevention, there does not seem to be any necessity for guarding against the attack as far as concerns live timber in this country, as the beetles have been very rarely observed. If there should be a desire to prevent attack spreading amongst fine old trees past their prime, which there was some especial reason to preserve, the only way that appears possible would be to fell and burn such as were known to be infested, and thoroughly to tar all parts of the standing timber where the wood was exposed without bark, or where cracks in the bark could be found down which the female beetles could creep to lay their eggs on the wood below. It will be noticed that we have no mention of the beetles laying *on* bark of growing trees.

The great damage is always stated to be what occurs to timber in dockyards, and the remedy suggested by Linnæus of having the timber in the royal dockyards in Sweden placed under water during the egg-laying season of the Dockyard Beetle, to ensure the wood against the eggs being laid on it, is too well known to need repetition. At the present day the matter would be more easily met by some of the many chemical applications, which are cheap, easy of application, and thoroughly deterrent to insect-presence. Probably an application of some mixture of paraffin or mineral oil would give an obnoxious scent to the timber for quite long enough to keep off the July presence of beetles.

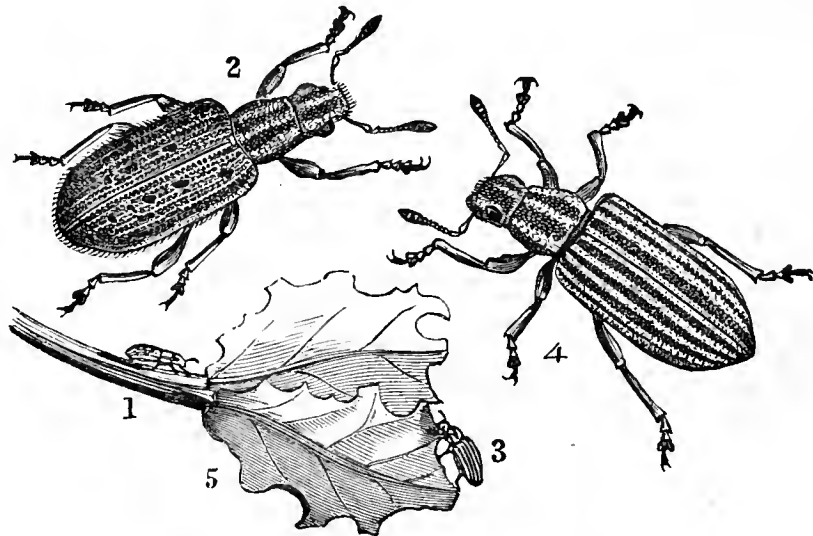
During the attack previously mentioned, when the *Lymexylon* broke out in such enormous quantities in Pembroke Dockyard, it was

* 'Forst. Zoologie,' von Dr. Bernard Altum. Vol. III., Insecten.

reported to Prof. Westwood (see paper previously quoted) that the maggots in the infested timber were destroyed by subjecting the wood in closed chambers to the action of steam for from eight to ten hours. This would check continuance of attack on the same spot very effectually, but I am not aware of the beetle being at the present time one of the regular injurious insects of this country.

PEAS.

Pea, Bean, and Clover Weevils. *Sitona lineata*, Linn.;
S. puncticollis (and other species).



SITONA CRINITA and S. LINEATA.

1 and 2, *S. crinita*; 3 and 4, *S. lineata* (nat. size and mag.); 5, leaf notched by weevils.

The following note, which was sent to me by Mr. Reginald W. Christy, of Boyton Hall, Roxwell, near Chelmsford, is well worth notice, as showing one of the situations in which the Pea and Clover Weevils, which are often such utter pests to the young crops in spring and early summer, and are to be found in legions on the "reapers" and in the waggons at harvest-time, spend their winter season.

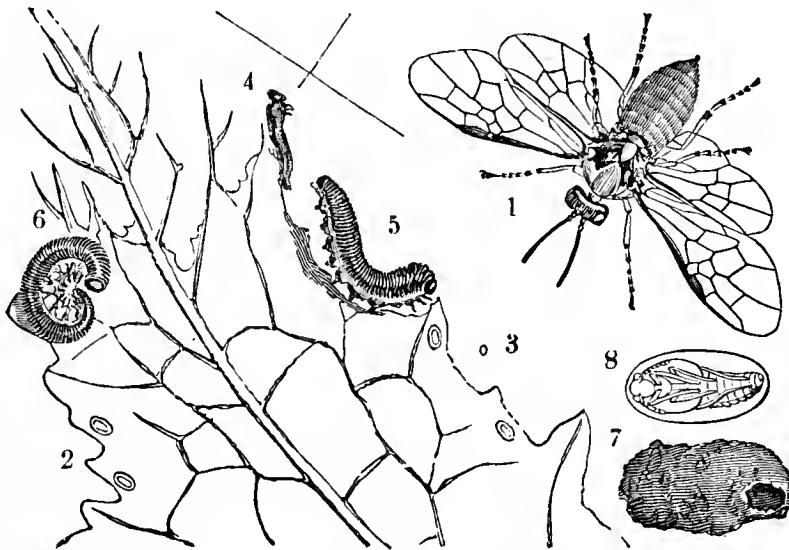
In this instance they came forth obviously from the stubble under pressure of weather, but in common circumstances they would have come out like many other kinds of beetles with the spring warmth to feed on their own special crop-food, and lay the foundation of a new attack.

"I think you would like to know of a fact which came under my notice on Jan. 6th last respecting *Sitona puncticollis* (or *lineatus*). After the heavy snowstorm we had on the 5th and 6th I found immense numbers of these beetles on the surface of the snow in a torpid state. The field was a barley-stubble, and the tops of the stubble just

protruded from the snow. I concluded that the weevils had hybernated in the hollow stubble, and that the snow had warmed them sufficiently to make them crawl out. Whether they got back again, or whether they were all blown off the frozen surface of the snow or not, I cannot say, but on the 7th there were none to be seen. This seems to show that they do hibernate in the imago state as well as the larva, and in large numbers, too, as I counted forty-one lying just in front of me whilst walking a hundred yards across this field."

TURNIP.

Turnip Sawfly. *Athalia spinarum*, Fabricius.



ATHALIA SPINARUM.

Caterpillars, pupa, and pupa-case. Sawfly, magnified, with lines showing nat. size.

In the course of enquiries regarding the Mustard Beetle and its caterpillar, sometimes known as "Black Jack," I received the following note from Col. Russell, of Stubbers, near Romford, regarding the caterpillar of the Turnip Sawfly, which goes popularly by the same name (that is, "Black Jack"); and as this insect, when it does appear, is rapidly destructive to Turnip-plant, I have (as suggested to me) added a few notes on the subject. Col. Russell observes:—

"The 'Black Jack' of your Report is not the caterpillar which I have known under that name. Some years ago these were very numerous and mischievous,—black caterpillars, something like an inch long, which eat off whole acres—sometimes whole fields—of White Turnip-leaves in autumn, leaving only the stalks and large ribs of the leaves. I have heard of flocks of tame ducks being turned into the fields to eat these caterpillars. Lapwings also are said to eat them. I do not remember seeing any of these for some years past.

Have they disappeared altogether? They are not noticed in your last Report, and I do not remember that they have been in the former Reports."

The Turnip sawflies are of a bright orange-colour, with black heads, and four transparent wings much netted over with veins (as figured), and yellowish at the base.

The first brood of flies appears in the early summer from out of the cocoons which have lain during the previous winter a little below the surface of the ground. The females lay their eggs on Turnips, and "all cultivated plants of the Cabbage tribe, and many of the wild Cruciferæ, as Charlock, Winter Cress, and Hedge Mustard."*

The eggs are laid in small slits in the leaf, which are cut by the "saw-like" egg-laying apparatus of the female, whence this family takes its common name of "Sawflies." One female is stated to lay as many as a hundred eggs. The eggs hatch in a few days, more or less according to the state of the weather being favourable or otherwise. The caterpillars are stated to be greenish white when first they come out of the egg; afterwards they are black, with a paler stripe on each side; and later on, when nearly full-grown, are slate-colour (with a pale stripe as before), and pale beneath. They have in all two-and-twenty feet (that is to say, a pair attached to every segment, excepting to the head and to the fourth segment from it, which is footless. The sooty colour, which they have almost throughout their lives, is the reason of the common names by which they are known variously, as "Black Jacks," "Blacks," "Black Palmers," "Niggers," &c.

The caterpillar feeds for about three weeks, and then goes down into the ground, where it forms a cocoon, in which it turns to the chrysalis condition.† From this the perfect insect comes out during the summer, after about three weeks, or in a shorter time, if the weather is hot. Later in the season these changes are not gone through so rapidly, and in observations of the winter cocoons the

* 'Praktische Insekten kunde,' von Dr. E. L. Taschenberg, pt. ii., p. 319.

† The description given by the well-known entomologist, the late Mr. Edward Newman (in his 'Letters of Rusticus'), of the method of formation of this earth cocoon is of much serviceable interest, showing, amongst other points, the thorough protection afforded by the case to the living contents:—"When the 'nigger' has reached his full size, a period depending on the temperature of the weather and the supply of food, but averaging at twenty days, he burrows in the earth, and there makes a little oval house, just big enough for his body, which has all at once become shorter and thicker; he then plasters the walls of this place with a sort of sticky varnish or glue, which he discharges at this time only: he keeps on discharging and spreading this glue till he is quite surrounded with a strong, tough, and hard cocoon, the particles of earth being mixed with the glue, and the whole forming an admirable and perfect defence against wet and the attacks of insects."—'Letters of Rusticus,' p. 103.

grub is recorded by Mr. Edward Newman as having been found by him lying within, and very little altered in the following May. From these chrysalids, as mentioned at the beginning of this account, the perfect sawflies come out to start the first attack of the summer.

The mischief caused by the sawfly-caterpillars when they appear, as is sometimes the case, in vast hordes, is enormous. They may be found swarming on the leaves, and will very rapidly clear away all that is not too hard to eat. Severe attacks have been recorded at intervals (and once during four successive years) since 1756, but I am not aware of a bad widespread outbreak having taken place for several years back.

In 1880 Mr. Robert Service, writing from Maxwelltown, Dumfries, mentioned that he had often met with the insect whilst collecting, and had met with it that summer as usual, but that it was rarely injurious in that neighbourhood; and in 1882 Mr. George Brown, writing from Watten Mains, Caithness, observed that a slight attack had occurred. He noted that "the damage sustained was but trifling; still, where they were at work can easily be seen, as there is nothing left of the leaves but the ribs."* The only occasion on which I have seen the attack myself—and then only as occurring to a slight extent—was on a Turnip field at the top of the cliffs above the Severn, at Sedbury Park, in W. Gloucestershire. This was in the autumn, and accompanied a high wind. From the state of the sawflies on first observation it appeared as if they had been carried by the gale from fields lower down the Bristol Channel, and thrown, partly exhausted, on the crop at the first high level, and very slight presence of caterpillar followed.

Very little can be done to prevent this attack, as we very rarely know when it is coming, but when it is present all the measures which succeed in checking attack of Turnip Fly by shaking the pest from the plants, such as sheep-driving, brushing with boughs, &c., and in all probability dressings obnoxious to the grub, will answer much more surely in the case of this attack, for the following reasons:—

The Sawfly-caterpillars eat voraciously, consequently grow fast, and therefore have to change their skins frequently, every six days or so. When this moult takes place they have to fix themselves firmly by the tail-pair of sucker feet to some part of the plant, so as to gain a point to pull against in drawing themselves out of the old tight and dead skin. If they cannot manage this they die in it. Therefore all measures which disturb them in this operation are very practically useful to us.

Also, it appears that up to the time of the first moult the caterpillar has the power of spinning a thread, by which it can let itself

* See Reports of Observations of Injurious Insects respectively for 1880 and 1882.

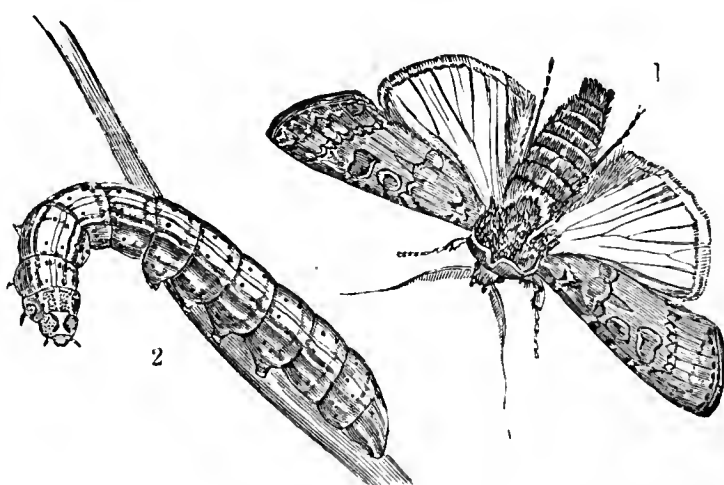
down on alarm, and (like many other kinds of caterpillars) return up the line to its food-plant when the alarm is over. But *after* the first moult the power is stated to cease, the caterpillar rolls itself up in a ring, and is easily dislodged, and falls to the ground. In this way, when the whole family at work on each plant is dislodged, some at least are killed by whatever the application may be, and there is a temporary respite.

Mr. Hart, of Park Farm, Kingsnorth, Ashford, Kent, reported, in 1880, that in August he had "used sheep and lambs with good effect in an attack of "niggers" on Turnips. About a hundred of them were driven backwards and forwards for an hour three days in succession, which *quite cleared the plants*, and did no harm to the animals. The attack was noted by Mr. Hart as the only one of the kind which he ever had to deal with, and he tried several other kinds of treatment before resorting to the droving, but they were all useless.

There is the special advantage, with regard to droving, that many of the grubs are trampled to death by the sheep; but any measures that will make the grubs fall down are serviceable. Any treatment that may give a temporary check to the plant whilst attack is on is particularly to be avoided; therefore singling and hoeing at such times are in no way desirable.

Where a Turnip field has been infested during autumn it is desirable to work the surface with a scarifier or grubber, so as to turn up the cocoons to the surface, where a good proportion of them, with their contents, are likely to be destroyed.

Surface Caterpillars; Caterpillars of the Turnip or Dart Moth. *Agrotis segetum*, Westwood.



AGROTIS SEGETUM.

Common Dart Moth; 1, moth; 2, caterpillar.

The following notes regarding Turnip caterpillars all refer to useful practical points, as--the benefit of a good state of land (such

as is neither sodden, nor with the moisture just below the surface dried out of it) at sowing-time, as a means of keeping up the crop under attack; attack of Turnip caterpillars to Mustard; the free use of drags and harrows amongst young roots as a means of disturbing the Turnip grubs, and bringing them within reach of Starlings and other birds; the serviceableness of hand-picking; and likewise observations of the grub being found alive in the ground amongst Cabbage-stumps during February. This last point is very well worth notice, for, though it is part of the regular history of this grub to live--and, circumstances permitting, to feed--through the winter, so little attention is paid to the matter that in due season many a hatching of moths is allowed to take place, and start attack on the young crops, which might have easily been prevented by a timely ploughing, which would have turned out a good proportion of the half torpid grubs to destruction.

On August 22nd Mr. Thomas Flower, of the Manor Farm, West Knoyle, Mere, Wilts, forwarded the following communication regarding attack by surface caterpillars to Turnip and Rape, which is of interest regarding the safety, or the bad injury, respectively occurring to the portions of the crop drilled on the first day of sowing before rain, or after a few days interval in wet weather. Specimens of caterpillars were sent accompanying. Mr. Flower mentioned:--

“The crop is drilled, three rows of Turnip and one of Rape. The first day’s drilling took place before the late rain, is of clean Rape, and has not been touched by the grub. The next day’s drilling of Rape and Turnip put in in wet weather after a few days interval is almost destroyed; in all about thirty acres is attacked by these pests. The soil is light flinty and backward. . . . One interesting fact is, the grub scarcely touches the Turnip, but destroys the Rape as it goes, and is to be found in the day-time hidden in the ground close to the root of the plant.”

(The method of feeding of the Turnip caterpillars, as they are called, though they feed on many kinds of plants, alters as they advance in age; when first hatched they are considered to feed chiefly above ground, or rather on the part of the plant just at ground-level, as often observable by the young gnawed-off plants which are to be found lying about; when older the grubs generally feed under ground, or come up at night to feed.--ED.)

The following report is from Mr. W. Farrant, of Stokes Farm, Wokingham, sent with specimen of Turnip caterpillar accompanying, on the 19th of August. It will be seen, in the case of two portions of a field of Turnips treated with the same farm manure, the same artificial manure drilled with the seed, and the seed in each portion drilled on the same day, that the portion which was ploughed

and laid in furrows about three weeks before being drilled was almost destroyed, whilst the portion which was ploughed one day and drilled the next escaped. Mr. Farrant mentions:—

“ I herewith send you three grubs. . . . I found them in a field of common Turnips after Vetches. The Vetches were mown and carried off for horses and cattle, twelve loads of farmyard manure per acre put on and ploughed in, and 4 cwt. superphosphate and dissolved bones in equal quantities (drilled in with the seed) per acre.

“ The spot attacked by grubs was where the Vetches were first cut, and the land ploughed directly and laid in the furrows about three weeks before being drilled ; in the rest of the field dunged in the same way, but ploughed one day and drilled the next (the same day and in the same manner as the attacked spot with two pounds of seed per acre), the seed grew well. The attacked spot will not be worth standing, whilst the other is looking well.”

The following observations, sent on the 23rd of August from Woolhampton Farm, near Reading, are of considerable interest, in reporting attack of the *Agrotis segetum* larvæ on Mustard. Specimens of the maggots were sent me, which I could not find to differ in any way from the common Turnip caterpillar, and (as we know well) several of the common Cabbage and Turnip insects also attack Mustard, there does not appear to be any reason why this caterpillar should not likewise feed similarly.

Mr. Colbauen mentioned that he sent me “ some specimens of a grub which had made great havoc lately in a field sown with Mustard for ploughing in green. The field is almost fifteen acres in extent, the soil being for the most part a light sandy loam. Large patches an acre or more in a place are almost entirely cleaned off, and there is a general thinning of the plant over the whole ground. At the base of the plant attacked there is a hole in the soil, from which the grub comes forth to feed upon the stem from its base upwards, as in the specimens sent. We have repeatedly grown Mustard in this neighbourhood, but have never known it to be attacked in a similar manner before.”

Relatively to the attack of this grub or caterpillar to other plants, Mr. Colbauen remarked:—“ I have battled with this enemy for many years, and have treated it with all sorts of dressings, but never found anything so effective on a large scale as the free use of the drags and harrows, especially amongst young roots. I have this year over 100 acres of good Swedes, Turnips, and Mangolds, only saved by the free use of the harrow. This brings the grub to the surface, so that the Rooks and Starlings can pick them up. I fancy Rooks do not care much for them, if they can get other food ; but Starlings seem very fond of them. I have a small patch of Mangold planted on the ridge

which we could not harrow, and, as it may be interesting to you to see how the bulbs have been injured by this creature, I have forwarded a specimen root, together with two of the caterpillars. Lime and chalk are great helps in getting rid of these pests; they do not like gas-lime."

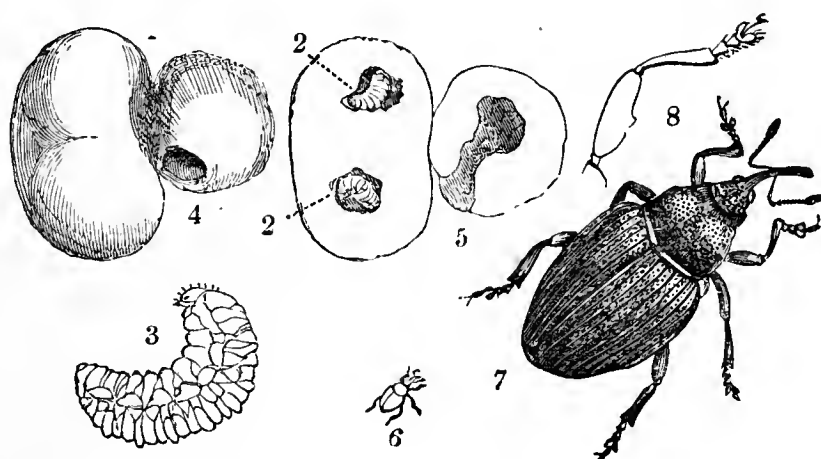
The following short note from Mr. James Craig, Weston-under-Lizard, Shifnal, Salop, refers to the benefit received from hand-picking:—

"I had large numbers of the grubs picked from the roots of my Turnips last year, after hearing from you, and thus, I think, saved a good portion of the crop."

The following note relates to the fact (which is not usually enough considered) that unless the Turnip grubs are destroyed by some means, natural or artificial, they will live on through the winter, and start fresh attack next year from the moths to which in regular course the caterpillars change.

Col. G. Coussmaker, writing from Westwood, near Guildford, observed:—"As regards my particular enemy the Dart Moth, I was astonished this last winter, in the middle of February, when pulling up some Cabbage-stumps, to find some of the caterpillars alive in the ground, and seemingly none the worse for the hard frosts which we had had."

Turnip-gall Weevil. *Ceutorhynchus sulcicollis*, Stephens.



CEUTORHYNCHUS SULCICOLLIS.

1—5, gall with maggot, nat. size and magnified; 6 and 7, weevil, nat. size and magnified; 8, leg of weevil, magnified,

Enquiries are occasionally forwarded regarding weevil-galls on Turnips. The appearance of these knobs or gall-growths on Turnip bulbs is very well known, and where they are only in small numbers they are of little consequence, but when numerous they spoil the appearance of the Turnip, and cause some amount of damage. But,

besides what harm the attack may cause, which, in the case of Turnips, except in rare instances, is perhaps not very much, the injuries are so often confused with those caused by the very destructive fungoid disease, known as "Anbury," "Fingers and Toes," or "Club," that a short note may be of some interest.

The galls caused by weevil-attack are simply roundish knobs, sometimes a few in number and separate from each other, sometimes in clusters, and, according to the stage of development, they may either be just a mere small swelling on the outside of the Turnip, or may project more, so as to be about the shape of a bullet cut in half, fixed with its flat side on the Turnip, or sometimes even more than this, so as to be of the form of nearly three-quarters of a bullet, or, in bad cases, they may be joined in clusters. Inside the galls are of the same (or of very nearly the same) condition of cellular tissue as the mass of the Turnip bulb itself, only with the centre eaten away by the maggot, and outside they are covered by the same kind of bark or rind as the part of the Turnip bulb on which they grow. This healthy state of the tissues, and regular, though abnormal, form of the galls, will be found to distinguish gall-attack very clearly from true "Anbury."

The beetle which gives rise to these Turnip-galls, and likewise the Cabbage-root galls, is a small blackish-grey weevil, with a long proboscis (see figs. 6 and 7, nat. size and magnified). The female lays her eggs either on the outside of the Turnip, or more probably just under the skin, by making a little hole for it with her proboscis, and from this egg there hatches the gall-maggot. This is a fleshy, whitish, legless maggot, with a head furnished with a pair of strong jaws. Those of the Cabbage and Turnip-gall maggots which I have examined were furnished with three finger-like teeth at the extremity.

From the irritation caused by egg-laying, or connected with the presence of the egg or maggot, the swelling known as the gall begins to form, and inside this the maggot feeds until it has formed a large cavity in the gall. When full-grown it gnaws its way out into the earth, and there it builds itself up a case or cocoon of the little fragments of earth or sand which are in reach, and in this cocoon (which lies in the cavity in the ground formed by the material for the earthen case being taken out of it) the maggot changes to the chrysalis-state. The maggots both of the Turnip and Cabbage galls appear little liable to injury from being thrown out of the galls before they are full-grown, or from having their cases broken afterwards. Those I have watched almost immediately buried themselves in the earth, and, if their earth-cocoons were broken they would make new ones or repair the damage.

The time occupied from the disappearance of the maggot into the

ground to the reappearance in complete development as the perfect weevil was, in the observations which I took in the middle of summer, never less than fifty-four days, and never more than the space of two months. I did not find that there was any difference between the weevils raised from maggots taken from Turnip or from Cabbage galls, and the maggots also were alike, excepting that the Turnip maggot was rather more ochreous than the other.*

When the galls are established on either Turnip or Cabbage there does not appear to be any remedy which can be brought to bear on the mischief that is then going on. Partridges are said to be very fond of the maggots, and to frequent Turnip fields for the purpose of pecking them with their bills out of the galls; but (as one great part of the damage of the attack consists in the escape of the maggot causing holes by which wet and injurious insects make their way into the Turnip) the still larger openings down into the gall-cavity caused by the birds' beaks are a doubtful benefit.

Good dressings of chalk and lime are stated to be good preventives, and so likewise is gas-lime. Anything that is injurious to the maggot, and which can be mixed in the earth into which it creeps from the gall to build up its earth-cocoon, must necessarily be brought strongly to bear upon its system, if not poison it outright. The maggots build up their cocoons by taking small fragments in their jaws, and adding them by means of a kind of gummy secretion from the mouth to the forming case, and if there is a supply in the soil of what is bad for them, and which will be partially swallowed in the house-building process, it cannot fail to be a preventive of increase. They have been recorded as going down out of the way of such annoyance deeper than the natural position for their change, and anything that places an insect when going through its changes in unnatural circumstances is very bad for it.

In garden cultivation the chief preventive is fresh deeply-dug soil, and to avoid ground on which Turnips or Cabbage have previously been grown.

* Maggots taken from Swede-turnips were of a still yellower tint, and those I observed differed in the small outside third tooth of the jaw, which was present in the Turnip and Cabbage-gall maggots, being absent; so that the jaws of the Swede weevil-maggot had only two teeth. I did not succeed in rearing the weevils from these, so cannot say whether they were precisely the same species.

WARBLES.

Horse Warble. ? *Hypoderma Loiseti*, Loiset; ? *Hypoderma equi*;
? *Ædemagena equi*.*

During the spring of last year my attention was directed to warble attack on horses, by Mr. H. Thompson, M.R.C.V.S., of Aspatria, Cumberland, who forwarded me a maggot which he had recently taken from a warble on the neck of a horse placed under his charge. On making enquiries it appeared that this kind of attack had not been generally observed, and also that it is not known with certainty what kind of Warble Fly (that is, what species of *Æstrus* or *Hypoderma*) it is that causes the warble. Therefore, during the past season, I have been endeavouring to gain some information as to the nature and amount of prevalence of the attack; and, so far as we have advanced, the following may be given as an abstract of the observations with which I have been favoured.

Warble attack has been noticed either on the living animal or on the removed hide at the following localities:—Wigton and Aspatria, Cumberland; near Tarporley and near Birkenhead, Cheshire; Hereford; Cirencester; Newport, Mon.; two localities in Cornwall; Downton, Hants.; Ely, Cambs.; and Lincoln;—so that the attack appears to be pretty generally distributed.

* The description of the larva given by Dr. Friedrich Brauer (although even in this case it is of the maggot before complete development) may be of some service in identifying the species in the coming season, and I therefore append it as a note, together with references to the authorities quoted by him, which, as far as I am aware, are all the published notes on the subject. Dr. Friedrich Brauer writes, in his 'Monographie der *Æstriden*':—

“The larva is oblong, thick, inflated at the fore part, and slightly smaller at the hinder part. The mouth is small, edged with a black border, and surrounded with prickles, which are scarcely visible to the naked eye. The first segment is the smallest of all; the five following increase up to the full breadth; the last five lessen considerably. On the under side of the segments it is observable that the surface (with the exception of that of the last two) is divided by a transverse furrow into two unequal portions; of these each is furnished with a number of prickles, of which those on the foremost half of the segments are placed with their points directed backwards, and those on the hinder half with their points directed forwards. On the last segment there are two horny spiracle plates. On the back the larva is nearly bare, excepting a slight amount of prickles on the first three segments. The body is white; the prickles dark brown. The skin of the larva is transparent. Enlargements at the side of the segments (*seiten-wülste*) either absent or inconspicuous. Length, 9—10 mm. On the under side of the second segment there is a cushion, which serves as a “pseudo-foot.” This is probably only a form of side enlargement.”

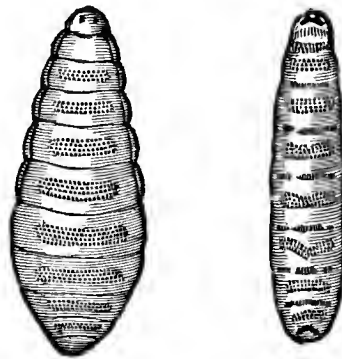
“From the description it will be seen that the larva may be judged to be in the second stage, in which it does not appear to show any especial difference from

The largest number of warbles noted on one horse were three or four, but usually not more than one was observed; but the mischief caused by this one either is (or has a capacity for being) much more serious than what is caused by any one warble on cattle. In the notes sent by Mr. Thompson, it will be observed that in the case of the horse suffering from warble, which was brought to him for veterinary advice, the swelling from the warble on the neck extended to the extremity of the shoulder-blade. Other notes of local tenderness of the part affected were given. It will also be noticed that the locality of the warbles is not (as with cattle) specially along the back, but they are also to be found on the neck, flank, and quarter. The only uninjured specimen I have seen much resembled the early stage of the Ox Warble maggot before it has gained the oval shape (see fig.).

It appeared to me that the bands of prickles were more obvious, likewise that the prickles were larger than is the case with Ox Warble larva at this stage, likewise that some of the divisions of the segments or cross furrows were deeper; but as the specimen was apparently not advanced to the final moult it could not be satisfactorily identified. In other specimens, examined by Mr. A. Martyn (see p. 93), the mouth-hooks were observable, and similar, or nearly similar, to those of *H. bovis*, and the duration of the chrysalis stage was found by him to be about

twenty-seven days.

The only other observations which have been contributed regarding points of structure of the maggot, or of the history of its development



Ox Warble maggot, in two stages, much magnified.

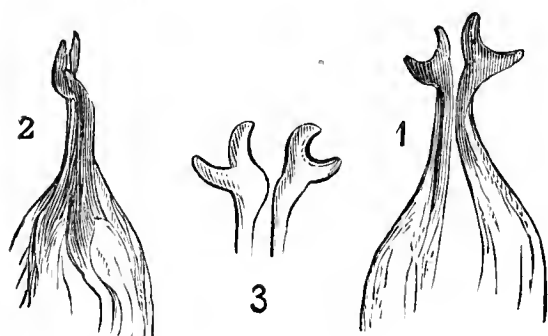
others of the genus. To distinguish whether it is the larva of the *Hyp. bovis* or of another kind, we must know the third stage. It is very likely that it belongs to another kind, possibly *H. silenus*."

"The larvæ have, up to this time, been observed in Spain, Italy, in the North of France, Belgium, Holland, and on the coasts of the North Sea, in warbles on horses. The statement of Joly that it occurs occasionally in the South, I consider to be inaccurate. I have never observed it in Vienna, nor on Hungarian horses. The swellings are found along the vertebral column on the back of horses, and are observable in May and June. Such horses especially suffer as in July and August of the previous year were exposed in the pastures to *Æstrus* attack."

"Note.—The larvæ observed by Roulin, in America, under the skin of horses, appear to belong to the *Dermatobia*."—*Monographie der Æstriden*, von Friedrich Brauer, Wien, 1863, pp. 137, 138.

The publications on the above subject, mentioned by Dr. Brauer, are:—Loiset, Note sur l'œstre cuticule du cheval, Mem. Soc. veter. d. l. Manche et du Calvados, p. 197, 1844 (*Edemagena equi*). Joly, Recherche s. l. œstre, H. Loiset, p. 241, 1846; and Joly, Comptes rendus d. l'academie, p. 86 (*Hypoderma equi* die larve, 88), Paris, 1849.

up to the perfect fly, were sent me by Mr. A. C. C. Martyn, a student at the Royal Agricultural College, Cirencester, who is well qualified to report on the subject, as in the previous year he had succeeded in rearing twenty to thirty Ox Warble flies to maturity from the larval state. During the past summer Mr. Martyn secured various Horse Warble maggots, and reared two of them up to fly state, these maggots being taken by himself from warbles respectively in the back of a colt and of a cart-horse. In one of the maggots the mouth-forks were noticeable on microscopic examination, and were stated by Mr. Martyn to be very similar to those of the young Ox Warble maggot, as sketched



Mouth-forks of very young maggot of Ox Warble, much magnified.

at "1" in the accompanying figure, repeated from last year's Warble report; the existence of bands of prickles was also noticed.

Of the two maggots which were reared to development, one was kept in a temperature of 100° Fahr., and remained in the chrysalis state for twenty-seven days. The fly which then emerged was reported by Mr. Martyn to resemble the Ox Warble Fly, but to be in his opinion somewhat longer in shape. The fly died in two days, and shrivelled up. In the case of the second maggot, which was reared to development, the craving for warmth was plainly showed. The box in which it was secured was covered with a convex lens, and on this being placed out of doors the larva drew itself from the darkened corner, where it had been laid, into the rays of the sun. These points agree with what I have noticed of the Ox Warble maggot, which I have seen restored when seemingly dead by being held in the warm hand, and which have power of movement, when free from the warble, in a selected direction. In both the above instances the flies soon died, and shrivelled or putrefied, so that they could not be kept as perfect specimens.

The first communication which I received regarding observation of the warbles was from Mr. Hy. Thompson, M.R.C.V.S., of Aspatria, Cumberland, who wrote to me on the 16th of April, as follows:—

“To-day I send you a warble maggot, taken from the neck of a thorough-bred horse. This is the third which I have removed during the last two years. The opening in the skin was about the size of a mustard-seed. About four hours before the animal was brought to me a small swelling was noticed, but to-day the swelling was diffused and extensive (nearly all the length of the shoulder-blade). The warble came away with very little pressure, but the parts were very painful.

The other two warbles were in the same animal,—one on the ribs, one on the quarter. About this time last year both places were very much swollen.”

On the 27th of April Mr. Thompson mentioned that another warble maggot had been taken (also out of the neck) from the same horse; and on the 14th of May Mr. Thompson wrote regarding another maggot, which had been forwarded:—“This is the third from the same animal, which is very peculiar, as you seldom see them. The extensive diffused swelling and effusion they cause in the locality attacked is something very remarkable; not so in cattle.”*

Messrs. C. and H. Hatton, of the Barton Tannery, Hereford, favoured me with information that they had known a few cases of horses being attacked by Warble Fly, but had never received a hide showing the effects.

On June 4th Mr. W. Fream, Professor of Zoology at the College of Agriculture, Downton, wrote me as follows:—“Regarding your query about warbles in the horse, I have only known one case. It occurred in a farm-horse here about six weeks ago. I was making inquiries, and learnt that the grub had been squeezed out only on the previous day.”

On Oct. 9th Mr. A. C. C. Martyn, student at the Royal Agricultural College, Cirencester, and writing from thence, mentioned that the attack was very rare in that neighbourhood, as he had only found one instance, although he had been to almost every farm within six miles of the College. In this case one warble had been observed, and the maggot squeezed out, and no more information was procurable about it.

In Cornwall, however, during the past year, Mr. Martyn had observed two well-marked instances of attack. The first was in the case of a colt, which he noticed in a field, under a hedge, flicking his tail and trying to bite at something on its back. On being caught and examined the animal was found to have three large swellings on its back, from two of which Mr. Martyn took the maggots. The second instance was of a cart-horse, which had three or four warbles on its back, these so far advanced that the air-pores at the end of the tail were visible, lying, as with the Ox Warble maggots, in the opening of the warble.

* This third maggot had been forwarded to me in Mr. Thompson's absence, and, though still in the cylindrical or worm-like stage, differed from that above described in not having any prickles, excepting a few much scattered at the tail extremity, and possibly, but not certainly, a few at the mouth end. The caudal breathing-pores were still very small, and the form of the mouth-hooks not clearly discernible. This maggot was so very different in amount of prickles to that forwarded to me by Mr. Thompson that I cannot take on myself to form an opinion of the species.

On July 25th Mr. Geo. Moore, Secretary of the Wisbech Chamber of Agriculture, mentioned, in reply to my enquiries regarding warbles in horses :—“ Mr. Luddington, of Ely, informed me that a few days ago he squeezed a warble-maggot from one of his horses (a nag-pony) fully developed, but not quite so large as the Ox Warble.”

On June 17th Mr. Ralph Lowe, of Sleaford, Lincolnshire, mentioned a case of a horse purchased at Lincoln putting up “ one warble swelling similar to those on cattle.”

Mr. Gaskell, of Prenton Hall Farm, near Birkenhead, also informed me, in conversation on the 18th of May, that he had at that time a young horse with a warble on his back; and Mr. W. Bailey, Head Master of the Aldersey Grammar School at Bunbury, Tarporley, Cheshire (an agricultural district where, as noted in the paper on Ox Warble Fly, the pupils have been doing good service in exterminating the latter pest), wrote me, on May 7th, that one of the boys, whilst grooming a colt during the previous week, had found a swelling on the neck, and squeezed out a warble-maggot; and that about a month previously two others of the boys had squeezed one out of the flank of a cart-horse. A careful inspection was made as to whether more warbles were present, but no more were found.

As the above kind of attack has not hitherto been much observed in England, it may be of some service to draw attention to it, as one which may (if occurring on a tender part, or one liable to be rubbed by the saddle) give a good deal of trouble if not attended to in time; and likewise as explaining the nature of lumps or knobs, of which the cause is not always fully understood. In the coming season I should be greatly obliged if those who have warble-maggots removed from horse-warble would favour me with specimens, and still more, if any who may develop the perfect fly would let me have the opportunity of examining it, as it would be both of use and interest to know the precise kind.

On May 31st I was favoured by Mr. Stratton, of the Duffryn, Newport, Mon., with the following information :—“ I have often seen warbles in horses, and they differ from those in cattle in the way you describe. You seldom find more than one in a horse, and that one is sometimes not in the back. . . . I have just now been examining one in a three years' old colt.”

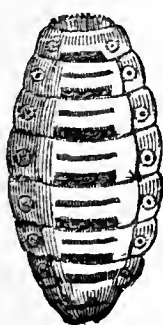
There appears to be peculiarity in some instances as to the size of the orifice, or date of opening of the warble, or duration of time during which it continues open; for Mr. Stratton noted, there does not appear to be any visible orifice in the warble as in the case of cattle, and, though in some cases the orifice is reported as large enough to allow of the breathing-pores of the maggot being seen, it will be observed by the following report of Mr. Dalton (which I have drawn attention to

by italics) that he has not noticed a scar on the healed wound in horse-hide similar to what exists in cattle-hide. Mr. Dalton, who in previous years had favoured me with excellent observations regarding warble-presence reported as follows:—

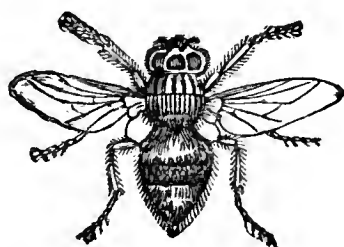
“With regard to your question about warbles in horses, I can give you but little information. Of the horse-hides I get I should say not one in fifty is warbled, and the appearance of the hides when tanned shows that warbles in the horse are of rare occurrence; *there is no cicatrix as in cattle*, and 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 these 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.”

Ox Warble Fly. *Hypoderma bovis*, DeGeer.



Maggot.



HYPODERMA BOVIS.



Chrysalis.

During the last season the chief points which have been brought forward regarding Ox Warble attack are the ease with which the warble-maggot may be destroyed, and the absolute certainty of greatly lessening amount of future attack by a little timely care in getting rid of maggots in the spring.

Where these are destroyed necessarily the summer hatching out of the warble-flies is lessened precisely in the same proportion, the cattle are (similarly) saved in proportion from summer disturbance, and from new deposit of maggots in their backs, and as the flies, as far as we know, are exceedingly short-lived and do not go far from where they came out of the chrysalids, each cattle owner has the

benefit of the trouble he has taken. This point is very observable in the following notes.

The various simple applications or measures by which the warble-grubs may be killed or removed with little trouble or cost, and much benefit to the animals have been mentioned so fully in previous Reports, that there is no reason to give them again in detail. It will be seen from the following instances that various different applications may be used with success; but, looking over the reports sent in for the two last years, McDougall's dip or smear appears to be generally preferred.

Where the owner or superintendent can himself direct operations, the application of mercurial ointment, *once*, and as a *small touch*, on the black-tipped tail of the maggot, as seen in the open warble, is a treatment which thoroughly and rapidly kills the grub, and does no harm to the cattle. But where the ointment is put on carelessly, or *in great quantities*, the application is too unsafe to be advised. Squeezing out the maggots is a sure cure, and, though somewhat unpleasant to the animal, is so popular that there is a chance of it being carried out to a useful extent; but, as mentioned in previous years, almost any application of a greasy or sticky nature, thick and firm enough to remain on the opening of the warble sufficiently long to choke the breathing-pores of the maggot within, or, again, of anything which will run down into the warble-cells and poison the maggot without injuring the animal, will be of use.

In the following notes I should particularly wish to draw attention to the first communication (by Mr. J. A. Smith, of Rise Hall, Akenham, near Ipswich) as to the detriment to dairy cattle caused by warble-presence, and also to that immediately succeeding by Mr. D. Byrd, of Bunbury Heath, Cheshire, relatively to the good effect of preventive measures.

Mr. J. A. Smith, writing from Rise Hall, Akenham, mentioned:—
“McDougall's smear or dip has apparently cured the bots on my purchased cows. I noticed that the animals affected seemed irritable under the attack, and this caused them to be troublesome to the milker. You will easily perceive that this is prejudicial to the milk-record, besides leading to a permanent loss, as well as trying the temper of the milkman. An inspection of the animals in our cattle markets at this season will convince the most superficial observer of the loss inflicted by bots on our herds and oxen.”

Mr. D. Byrd, writing from Bunbury Heath, Tarporley, Cheshire, on April 4th, mentioned:—“We dressed our dairy cows with dry sulphur, as I informed you, and they are very free from the warble; at the same time there are a few with suspicious lumps, that we shall notice to find if they are old sores or the warble in progress.”

On August 21st Mr. Byrd wrote further:—“It is pleasing to know that the Warble Fly is greatly lessened; the maggots must have been well looked to, and the preventive measures properly applied. We are all greatly indebted to you for the information how to destroy the maggot, and stock-keepers have wisely attended to instructions.”

On March 12th Mr. W. Bailey, Head Master of the Allersey Grammar School, Bunbury, near Tarporley, wrote me that Mr. F. Ravenscroft, one of his pupils, had examined 114 head of stock belonging to his father and brother, and “so far had found no trace of the warbles”; and later on, on the 2nd of June, Mr. F. Ravenscroft, writing from Calveley, Tarporley, reported, as below, that there had been little trouble from warbles in the stock which had been dressed in the previous year, but they were found in young stock which had not been dressed. “We are not much troubled this year with the ox warbles. Last year’s dressings have nearly stamped out this pest. We have, however, some of these maggots in the young stock which were not dressed last year, as they were out in the fields. I have this year applied the smear [McDougall’s, Ed.] to them, though I prefer, if possible, to squeeze them out, as I am not sure whether it is a good thing to leave the dead maggots in the beasts.”

The following note regarding efficacy of McDougall’s dip was contributed by Mr. John Searley, of the Croft, Wainfleet:—“I have several warbles on young cattle: have tried McDougall’s dip, and find it effectual. Some of the more mature bots came out, or were squeezed whilst being dressed. Others seem to rot in a few days.”

On February 4th Mr. John M. Moubray, of Broom Court, Alcester, favoured me with the following note:—

“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. I fancy that yearling cattle are more subject to the attacks of the fly than older cattle.”

The following note from Mr. J. A. Farrell, D.L., of Moynalty, Kells, Ireland, mentions a glycerine dip as serviceable. “I have treated a good many cattle of all ages this season with glycerine dip, with very successful effect. I think it adheres longer to the coat than McDougall’s dip, and it has the effect of improving the hair, especially in calves.”

The two following reports refer to the use of mercurial ointment. The first is from Col. G. Coussmaker, of Westwood, Guildford:—

“ My experience of warbles in the cattle is now this much:—In 1884 the majority of the cows and heifers had each from five to twenty in their backs. I got mercurial ointment, put some on myself, and showed the stock-man how to use it. In 1885 there was much less, and now there is hardly a case among sixty head; so I think that, thanks to your advice, my animals have now more ease. When I first began to talk to the men about it they said that it was nothing,—cow-stock always had these things; it did them no harm, and, as a rule, those which were in best condition were more likely to have them, and, in fact, that it showed the animal was healthy and thriving. Curious argument.”

On April 4th, Mr. E. E. McBride, of Glendonagh, Midleton Co., Cork, wrote as follows:—“ You will remember our correspondence of last year on the warble. I went carefully over all my cattle and poisoned the grubs with mercurial ointment, and I gave several of my neighbours some, and their cows were also treated. So careful was I with my own beasts that I do not think a single live grub escaped on this farm. The result is that this season the warbles are decidedly fewer, many of the cows being quite free from them.”

It has now been proved by the information contributed during three successive years (for which I am indebted to cattle owners, dairy farmers, and others well acquainted, veterinarily and practically, with the management of cattle) that by a little care bestowed in the early part of the season, in destroying the maggots before they leave the warbles, that warble-attack may be so lessened as to be of no serious injury,—in fact, may be almost “ stamped out ”; and further, as before mentioned, that, from the nature of the warble-flies, this is one of the attacks in which each man benefits by his own work.

Communications have been sent in from tanning and hide firms, notably from such centres as Newcastle, Wigton, Birmingham, Hereford, Bristol, Taunton, Exeter, and from elsewhere, with mention of great extent of the losses sustained, and often urging strongly on myself to take all measures in my power to draw attention to the public loss. I have also information from those inconvenienced by the damage to the injured hides, affecting (that is to say, causing both trouble and loss to) manufacturers of goods from the perforated leather.

But still there is enormous difficulty in getting action taken to destroy the pest. I believe that the root of the difficulty is *ignorance and carelessness*. Until a very few years ago the history of the attack was not generally known; now, through the observations taken in Great Britain and Ireland, not as abstruse scientific points, but as simple everyday facts, all can know, and see exactly for themselves, how the matter lies; but there is still (and necessarily and without

blame, for those alluded to have not had time to get the information as yet) a great part of the old ignorance and superstition remaining amongst those who have the immediate charge of the cattle as to the cause and effect of the warbles.

So long as there are ideas abroad that warbles are caused by the fresh grass, or that they are humours of the blood, or that, on the other side, they *show* a healthy state of the beast, or *cause* it, because "boils are healthy," so long shall we have half-hearted help or none at all from those in whose hands, literally speaking, the cattle are placed, and as a matter of course, and as may be seen any day at cattle-fairs, those who bring the infested cattle will vouch for the state of hide being rather advantageous than otherwise, and so spread the false theory and practice together.

In this class there is an utter carelessness what happens unless the beast dies, or, if it does die from mortification or other causes connected with the diseased state of the hide, even this is often ascribed to other causes, and till *they* are got to understand *we* must suffer. If, instead of merely looking at the outside of the hide with a minute puncture showing here and there, but otherwise with little sign of disease noticeable, the *inside* could be exhibited just as it is when newly flayed from an infested beast, a very different idea would be given. None who saw the great lumps, with the maggot an inch long, lying and sometimes moving in each, with the shape showing through the thin film to which their own suction and the ulceration caused by it had worn the flesh-side of the hide, the putrid holes where the maggots had burst out in flaying, and in some cases the state of inflammation of this inner surface, could for one instant consider the attack beneficial.

It has been advanced lately that it is the best hides that are attacked by the Warble Fly. Whether this is so or not, it is not in my power to say, as the opinion is not universal; but even if it is so, it appears to be no reason why part of the best hides should be rendered useless.

The point of the attack, however, which all *can* see, and which all concerned look on with unbounded annoyance, is the summer attack of Warble Flies to the cattle in the pastures. Then the loss of flesh on fattening beasts, the loss and injury to quality of milk of the cows, and likewise damage to health in various ways from the animals tearing about as fast as they can go, is a real grievance; and it is this which first of all may be lessened or altogether checked by destroying the maggots in the earlier part of the season.

A great advance has been made in practical application of knowledge lately gained, and in some places where owners have been at the pains to give their herdsmen the requisite information, nothing could

be desired greater than the care taken, and if this same care was spread over the country this time-honoured trouble would be put an end to as far as concerns any serious consequences.*

* For information as to extent and nature of loss, means of prevention, and history of the fly in different stages, with full illustrations, see 'Observations on Warble Fly' and 'Second Report on Warble Fly,' by E. A. Ormerod. Simpkin Marshall & Co., Stationers' Hall Court, London, E.C. Price, 3d. each.

APPENDIX.

Hessian Fly. *Cecidomyia destructor*, Say.

(Continued from page 25.)

DURING the winter further communication has been forwarded regarding Hessian Fly, showing its presence to be more widely distributed than was at first supposed; also regarding observation of the puparia or "flax-seeds" in the siftings beneath the machines; and other information bearing on spread, or prevention of spread, of the attack, of which I give some of the main points, as follows:—

"FLAX-SEEDS" OR PUPARIA.*

On January 17th of the present year (1887) some specimens of Hessian Fly "flax-seeds" were forwarded to me by Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., with the information that he was then finding a good many of them between the blade and stalk on Wheat straw. In reply to my enquiry as to where they were found, Mr. Taylor wrote, on January 22nd:—"I have found them in the stack before being threshed; amongst these the sample sent to you. I have found them on the straw after being threshed; it was on this that I first found them; and since reading your pamphlet I have found them to the number of seven in a small handful of Mustard and other such small seeds, which fall through the sieve, after going over the mill-fanners, and also two sets of dressing-fanners with which our threshing machine is furnished. The two former were Wheat, the latter barley. I at first thought that the pest was only to be found on Wheat grown on light land after Potatoes; but after further observation I find it on Barley grown both on fine light black soil and heavy clay (for we are situated in the centre of the Carse of Gowrie)."

The number of farms in the district on which "flax-seeds" have been reported as observed up to the 24th of February was nine,—eight in the parish in which Daleally is situated, and one about six miles more to the west on the border of Kinfauns parish. The area of the

* As before mentioned, the chrysalis-cases or puparia of the Hessian Fly are called "flax-seeds" from the great resemblance which they bear to this kind of seed both in shape and colour.

farms (where specified by Mr. Taylor) runs from about 160 or 200 acres to 400 acres. Mr. Taylor further communicated, in a copy of a letter sent by him to the 'Dundee Advertiser,' February 1st, that he found the "flax-seeds" on Barley grown both on light and heavy soils, and "pretty thick among Mustard and other small seeds, which fall through the sieve of the fanners below the threshing mill."

The amount of the "flax-seed" found in the siftings has been reported on different inspections as seven in a small handful, twelve in the handful, and "pretty thick" in the small seeds and rubbish beneath the machine,—an amount of pest presence enough to infest the whole neighbourhood.

In regard to this point of the "flax-seeds," that is to say the chrysalids or pupa-cases of the Hessian Fly from the infested straw being found in the fine siftings under the machine, I received a further communication on the 7th of February from Mr. Geo. E. Palmer, of Revell's Hall, near Hertford, who, it will be remembered, was the first observer of the "flax-seeds" being thrown down in the fine siftings, that he has found more or less of these "flax-seeds" present in them on most of the farms "where he has had opportunity for observation in his own neighbourhood." The amount of fifteen in a handful have been found by Mr. Palmer on his own farm.

It is impossible to over-rate the importance of the observations of the "flax-seeds" being thrown amongst the fine siftings as a means of prevention of some portion of the spread of Hessian Fly. There is little trouble and no loss in gathering up the collection of dirt, weed-seed, and insect vermin, and destroying it all in whatever way may be most convenient. In regard to this point, Mr. G. Palmer observed:—"I have taken every precaution, both in destroying the siftings and in treating the infested straw when made into manure in such a manner as to kill any of the pupæ that may have been left in it, *viz.*, by letting it heat in clamps for some time before spreading it on the land. We shall also take care to remove all the straw from the fields early in the spring, so as to prevent the flies from hatching out and laying their eggs on the young Corn when it comes up." If these precautions are taken we shall hold the attack in check, but if precaution is not taken there is great reason, judging by what happens in other countries, to fear severe loss.

"FLY-PROOF" WHEAT.

One of the measures by which it is possible to lessen amount of loss on crop, even where attack takes place, is growing what is called "Fly-proof" Wheat. It may not escape altogether, but by reason of the hard strong stem the fly-maggot makes little way with its injury. This is one advantage; and, secondly, where there is such a stem (either from special kind or from good cultivation) that it continues to

carry the ear well up, instead of falling down at an elbow above the attacked spot, this is an immense saving.

In the experimental ground at the College of Agriculture, California, it was found that in 1886 of 100 kinds of Wheat grown the only kinds that did not suffer were solid-stemmed Wheats. In Canada and the United States various kinds of Wheats are considered to be more or less "Fly-proof," and this point is well worth consideration.

In the Barley on exposed land at Revell's Hall, which I examined, the plant was weak, and it had elbowed down and was seriously injured. The heartier plant on cooler ground had suffered less loss; and recently, relatively to the same points, Mr. D. Taylor wrote me from Errol that enquiry had been made of him by various farmers whether the Fly was likely to do much harm to the crops, as they considered that little difference was distinguishable between what was and what was not attacked. In the instances of the pieces of infested Wheat-straw sent me, this had been firm and strong; and though in one case there were three fine "flax-seeds" nearly at one spot, the straw had not elbowed. Looking at this point in connection with it being considered that much damage was not done, and at the American and German observation that damage is prevented by using Wheat which is strong-stemmed, either by special kind or judicious cultivation, it appears well-worth while to consider the matter for practical service. In the words of Dr. Balthasar Wagner, of Fulda:—"Plants grown into stout stalks on rich soil render such a considerable resistance to the attacks of the maggots that most of them will mature their ears. The sparsely-nourished stalks of a field are easily bent." The kind of Wheat that will answer of course will vary according to climate, soil, &c.: one of the kinds, much grown in the Carse of Gowrie, is a reddish Wheat, known as "square" or "club-head"; the other, a white Wheat, of which I have not yet got the name.

The points mainly to be attended to at present to prevent spread of attack, or great damage if it comes, are to destroy all "flax-seeds" in screenings, and so treat the infested straw as mentioned above, and, in the circulars and pamphlet by Mr. Whitehead, that the pest in them may be destroyed; likewise by all means possible to procure a hearty, sturdy stalk;—and also to bear in mind that as this attack only, as far as is known, affects Wheat, Barley, and Rye; that growth of Oats amongst the Cereals, or any of the crops included under the head of roots, as Turnips, Mangolds, Potatoes, &c.; any pulse crops, as Peas, &c., or any crop, such as Cabbage, Mustard, Flax, or ground or bush fruits, would be safe from any damage from Hessian Fly, and beneficial to the country by giving a total check to possibility of spread of this noxious pest on the area so occupied.

RATE OF SPREAD OF HESSIAN FLY.

In Russia the Hessian Fly is very injurious; and I am favoured by the kind permission of Dr. K. Lindeman, Professor in the Academie Agricole of Moscow, Russia, who was the first discoverer of its presence in that country, to offer the following extract from communications he has lately been good enough to send to myself, and which I give in detail, as the testimony to such enormous powers of spread, from Dr. Lindeman's own knowledge, is exceedingly instructive in our present trouble. Dr. K. Lindeman wrote, during February last:—"The *Cecidomyia destructor* was discovered by myself first in Russia, in the Government of Poltowa, in July, in 1879. Since then I have myself studied it in many parts of the country, and received puparia from very many correspondents, and up to the present time I am aware of the presence of this injurious insect in the following Governments:—Bessarabia, Vladimir, Vologda, Vollandia, Voronetz; in the country of the Don Cossacks, Ekaterinoslav, Kazan, Kaluga, Kiev, Kostroma; in the country of the Kuban Cossacks, Kursk, Mohilev, Moscow, Nischny-Novgorod, Novgorod, Orel, Penza, Podolia, Poltowa, Pskov, Perm, Riazan, Samara, Saratov, Simbirsk, Smolensk, Stavropol, Tambov, Tula, Kharkov, Kherson, Tschernigoff, Estland, Jaroslav, and beyond the Ural Mountains the Hessian Fly occurs in the district of Schadrinsk (Government of Perm). In this wide extent of territory the Hessian Fly causes with us yearly very severe injury, which rises to a great height, especially in Southern and Mid-Russia."

It will be observed from the above details that in the course of eight years, from the first observation of its presence, this crop-scurge has spread over an area of country extending from the more northerly parts of Russia to the shores of the Black Sea, which may be generally described as a square length and breadth, exceeding in some parts twice the length of England and Scotland taken together. *Unless timely precaution is taken here, the above note shows what we have to fear.*

The point still remains to be found out,—Where does Hessian Fly come from? It is most likely that it is imported in straw or in Corn not cleared of the fine rubbish and weed-seeds, which have to be cleared out in this country if the Corn has not been thoroughly cleaned before shipment. We can only learn whence it comes by careful watching. It is exceedingly desirable that all who use imported straw, either for litter or bedding, or for fodder, would, as a regular thing, see if it contained "flax-seeds." Splitting open a sheathing-leaf at the second joint of the stem here and there amongst Wheat or Barley straw when known to be imported, would help greatly towards knowing if the pest

was present, and a small *bonus* promised to the farm men (whose business especially brings the straw through their hands daily), to be given on discovery and production of infested specimens, would ensure a good watch. A formal inspection in the stores might very likely give no results, and would require the baled straw to be loosed; but a watch kept on the straw, also on slightly-used litter and on long manure, would be well worth while. A watch on screenings from imported Wheat and Barley is also highly desirable.

“FLAX-SEEDS” IN LIGHT CORN OR “SHAG.”

March 12th, 1887.—Whilst the above pages have been passing through the press further discoveries have been made of the place of deposit (during threshing infested straw) of the chrysalis-cases or “flax-seeds” of Hessian Fly, which bear very importantly on the subject, of means of spread, or methods of prevention of attack.

During the last few days I have received information from Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., that he not only finds the “flax-seeds,” as before mentioned, in the “siftings,” but that they were still more easily observable “in the light grain or ‘shag’ which fell immediately behind the dressing-fanners, or is delivered at the side by a ‘shag’ or tail-spout, also amongst the earth and small weed-seeds which fall through the sieve below the fanners.”

The proportion of “flax-seed” to the handful was found to be much larger in this light corn or “shag” than in the siftings. In these the amount of “flax-seed” ran to about twelve to fifteen to the handful, but in the light corn as many as nearly forty to the handful were found, and in a four-gill measure of light grain, as it came from behind the dressing-fanners, Mr. Taylor found “*some few over ninety.*”

This discovery, which, it should be remarked, is from an observer perfectly cognizant with appearance of the puparia, is of grave importance. It not only shows how attack may be reinstated from our own threshings on to our own fields, and therefore that every farmer through the country should be on the alert, both on his own land and in his own neighbourhood, in bringing about clearing of the “flax-seeds” from the light corn, and destruction of the same by all means in his power, but further, it points to how attack may come in foul imported grain. Where this is sent to us uncleaned from infested countries there is fullest likelihood of Hessian Fly “flax-seeds” being transported amongst the weed-seed and small rubbish, and those who buy cheap screenings should be alive to the fact.

Eelworms. *Tylenchus devastatrix*, Kuhn.

(Continued from page 47.)

"TULIP-ROOT" IN OATS.

In the case of Tulip-root attack it is of great importance to know what is the precise kind of Eelworm which causes the disease, because, as previously mentioned (p. 37), there are some kinds which are so very long-lived that they may remain in the land for years, and thus be ready to infest any crop put in that may suit them.

It is now in my power, through the able assistance most kindly granted me, to state that the kind of Eelworm present in specimens of our English Tulip-root disease in Oat plants has been found to be the *Tylenchus devastatrix* of Kuhn, formerly known as the *Tylenchus dipsaci*, Kuhn, but of which it was considered desirable to change the special name, on account of the variety of crops which it has been found to *devastate* or greatly injure, instead of being more particularly hurtful (as was formerly supposed) to the Teazel (*Dipsacus fullonum*), whence its specific name of *dipsaci*.

I beg to acknowledge with many thanks my obligation for the following notes to the information kindly given me by the eminently well-skilled observers, Dr. J. G. de Man, Middleburg, Netherlands, late Conservator of the Museum, Leyden; * and Dr. J. Ritzema Bos, Professor of Zoology at the Agricultural College, Wageningen, Netherlands, who has studied this Eelworm disease for many years, and has written upon the subject, with valuable details of his own experiments, and is shortly about to publish a Monograph on this and on other species of Eelworms (*Nematodes*) injurious to crops.

It appears that this disease was first observed on Rye, and the name of Stock-krankheit, or more shortly "Stock" (which may be translated stem-sickness, or more shortly the "Stem") was bestowed upon it; and afterwards the same species of Eelworm was found to cause the "Stem" also in Oat plants. The above term draws attention much in the same way as our own term of Tulip-root to the nature of the attack affecting the development of the stem. As in the middle of the winter there is much difficulty in procuring fresh specimens, I could only offer for investigation young plants of winter Oats from the infested field, mentioned at p. 43, and also some stubble from the field marked 1886 in the plan given at p. 42; but although the diseased growth was only just slightly showing as yet in the former, Dr. Ritzema Bos found therein specimens which he determined as being certainly the *Tylenchus devastatrix*, Kuhn, a few of them being fully developed.

* Author of the work on Anguillulidæ, entitled, 'Die frei in der reinen erde und in sussen wasser lebenden Nematoden der Niederlandischen Fauna.' 34 plates.

In the dead part of the stubble from Arniston mains only a few *Tylenchus devastatrix* were present, it being a habit of these Eelworms (as far as has been observed in Rye) to leave the dying plant; but Dr. Ritzema Bos "found this species in somewhat greater numbers in the young shoots that were springing from the haulm of the Oat stubble, which were still alive and green. *All these were without doubt Tylenchus devastatrix.*" Other Anguillulidæ, or Eelworms, were present in the dead part of the plants, or in the earth hanging about them, belonging to the genera *Diplogaster*, *Cephalobus*, *Rhabditis*, *Mononchus*, *Plectus*, and *Dorylaimus*, of which Dr. J. R. Bos observes that "all these live in humus or in earth, and are not plant parasites, and cannot possibly be the cause of Tulip-root disease."

Further I may add that early in the correspondence I forwarded a few plants remaining to me of specimens of last season's Tulip-root, then quite dried up, to Dr. J. G. de Man, who was so good as to examine them, and pronounced that he found specimens therein of *Tylenchus*, which he considered to be *Tylenchus devastatrix*, Kuhn, but these being dead, and not sexually developed, he could not speak with absolute certainty of the species; but later, in a few specimens of Tulip-root from the same packet, above alluded to (from field mentioned at p. 42), Dr. de Man found a perfectly developed male of the *Tylenchus devastatrix*, Kuhn. From the fact of this species of Eelworm being found in our English "Tulip-rooted" Oat plant, as well as in the German similarly diseased plants, there is now no reason to doubt that this, namely, the *Tylenchus devastatrix*, Kuhn, is the cause of the attack.

The *T. devastatrix* is considered to be the only species of Eelworm that causes Tulip-root,* but many other kinds are often present, either in or amongst the sheathing-leaves or the roots of the Oat plants. As it is impossible for any but those who have long and minutely studied the subject, and also are aided by strong microscopic power, to determine the differences between these kinds correctly, I do not give the descriptions; but having been so greatly favoured by Dr. de Man as to receive from him a list of the different species which he found present, in or accompanying the Oat plants I forwarded to him, I, with his kind permission, give this information, as it will be of much interest to students of the subject before passing on to means of prevention of Tulip-root. Dr. de Man wrote to me:—"I have found *Cephalobus rigidus*, Schneider, which is identical with *Cephalobus oxyuris*, Bütsche,

* For description and figure of the *Tylenchus devastatrix*, by Dr. Kuhn, see 'Zeitschrift für wissenschaftliche Zoologie,' T. ix., p. 129, plate vii. c. Likewise, by the same author, 'Die krankheiten der Kulturgewachse,' Berlin, 1858, p. 179, and plate v. It is also described in Dr. H. Charlton Bastian's "Monograph of the Anguillulidæ," vol. xxv. of the 'Trans. of Linnean Soc.,' p. 128.

very frequently at the base of the stem on the inner side of the delicate sheaths by which the stem is surrounded. This species was not yet known as occurring in England. On these sheaths I also observed some specimens of *Aphelenchus modestus*, de Man, both male and female; and the following species were moreover found, though some of them probably occurred in the adhering earth:—*Monohystera simplex*, de Man; *Mononchus papillatus*, Bastian; *Mononchus bidentatus*, de Man; *Cephalobus striatus*, Bastian; *Plectus granulosus*, Bastian (see fig. 3, p. 36 of this report); and *P. cirrhatus*, Bastian.”

With regard to the three species figured (from Dr. Bastian's Monograph at page 36, to give some idea of differences of structure in various kinds of Eelworms), Dr. de Man mentions that he “had found *Plectus granulosus* to be one of the commonest species, living in the soil, and distributed throughout the whole of Western Europe.” “*Tylenchus obtusus* is most closely allied to *T. dubius*; the latter species, however, is nearly as common, and as widely distributed” in the soil as the *Plectus granulosus*. “*Aphelenchus avenæ*, however, hitherto was never,” Dr. de Man observes, “found by me in the soil, and I presume that it inhabits the plants without causing a disease.”

The following notes give some additional information as to methods of prevention and habits of this Eelworm, with which I have been favoured by Dr. J. Ritzema Bos:—

“As soon as the ‘stem-sick’ Rye begins to die, and the haulm to turn yellow (as during the ripening of the Corn, but often much earlier), the *Tylenchi* begin to wander from the upper to the lower parts of the plants, to finally leave the plants and live in the ground (usually in a state of suspended animation). Thus the *Tylenchi* begin to travel directly the plants begin to die, and much sooner. But directly the plants are entirely dead, or dried up, the *Tylenchi* cannot travel farther, because they pass into a state of torpidity in the dried tissues. Thus, because during the ripening of the Rye and the withering of the plants, most of the *Tylenchi* wander from them into the earth, the earth thus becomes infested. But as *all* the *Tylenchi* have not been able to leave the plants before the complete withering or ripening, the straw and also the stubble will always contain a greater or less amount of these Eelworms, more especially as during the ripening of the Rye eggs of this Eelworm are still to be found in it, which of course cannot wander away.”—J. R. B.

Therefore, as is pointed out by the Professor Dr. J. Ritzema Bos, above quoted, the stubble cannot be ploughed in without danger, because there is still presence of Eelworms in it; and if it is burnt directly the crop is cut, though we get rid of those that are in the stubble, there are still the great number which have travelled into the

ground remaining. This attack is most difficult to deal with when once established. It is most easily carried out to the land in small quantities, as mentioned at p. 46, and establishes itself in patches, as seen in the map. If such patches are ploughed across, or indeed if they are left alone, the Eelworms spread thence and gradually get hold; and, as before mentioned, attack Oats, Rye, Buckwheat, Clover, and Teazels amongst common crops, and Wild Teazel and Corn Blue-bottle amongst weeds. It is also mentioned as infesting the two common grasses,—*Anthoxanthum odoratum*, or Sweet-scented Vernal-grass; and the *Poa annua*, or Annual Meadow-grass; and the common Buttercup, or creeping Crowfoot (*Ranunculus repens*), which may prove to be a reason for attack being found on broken up grass-land; likewise the Ribwort Plantain (*Plantago lanceolata*); the *Polygonum convolvulus*, which is nearly allied to Buckwheat; and also Spurrey. And further, from experiments carefully tried, there seems no reason to doubt that it also infests Onions; and as decayed Onions are commonly wheeled out to the farm rubbish-heap, this circumstance may turn out to be the reason of the little patches of attack sometimes noticeable.

It is probable that a dressing of fresh gas-lime put on the patches so thickly that it would kill the "wormlets," and everything that was there or was put in for months after, would be the best treatment where merely small patches are found in clean ground; the little bits of land could be spared, and the centres of infection thus probably totally destroyed. Enormously deep ploughing or trenching, as mentioned at p. 46, is of use, because it puts the Eelworm down where it will die; but the remedy is very difficult to carry out, both on account of its expense and of bringing up unimproved soil to the surface.

After long search in special works on the subject, and the benefit of special consultation, it appears to me that the main points to be attended to are:—1st, Carefully to avoid spreading the infection, either in infested litter, common farm manure, or dung, as it appears that the wormlets may be passed through the cattle without injury. 2ndly, To avoid spreading it by means of infested earth carried in any way about an infested field, or from one field to another; but that the only thing really to be trusted to in case of attack is to exclude crops subject to this Eelworm (which are mentioned above, and in the preceding paper at p. 46) from the rotation till the land is again clean.

LIST OF CONTRIBUTORS

TO

REPORT ON MUSTARD BEETLES (pp. 58—76).

- ABBOTT, W., Serpentine House, Wisbeach.
BANNESTER, A., Barling, Rochford, Essex.
BRAND, T. P., Foxearth, Long Melford, Suffolk.
CASWELL, C., Peterborough.
CATLING, Capt. R. C., Needham Hall, near Wisbeach.
EGAN, S., Wryde House, Thorney, Peterborough.
FREEMAN, J. W., Dadlington, Hinckley, Leicestershire.
FULLER, A., Ramsey, Hunts.
GREEN, W. W., Manea, Cambs.
HARRINGTON, A., Rochford, Essex.
HARVEY, C. C., Foulness, Great Wackering, Essex.
JAQUES, T. E., Blacktoft, Howden, Yorks.
LITTLE, Professor H. J., Coldham Hall, near Wisbeach.
LITTLE, W. C., Stags Holt, March, Cambs.
LOWE, RALPH, Sleaford, Lincolnshire.
LUDDINGTON, J. L., Littleport, near Ely.
MEESON, W. M., Battles Bridge, Essex.
MOORE, GEO., Redmoor, Elm, near Wisbeach.
REED, Col. LANCELOT, Elm, near Wisbeach.
SEARS, R. H., Manea, Cambs.
SMITH, E., Southminster, Maldon, Essex.
TIBBETTS, J., Asham House, Doddington.

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