FIRST REPORT

ON

ECONOMIC BIOLOGY.

BY

WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.,

Foreign Member of the American Association of Economic Entomologists; Joint Honorary Secretary of the Association of Economic Biologists; Editor of the "Journal of Economic Biology"; Honorary Consulting Biologist to the Land Agents' Society, the Midland Reafforesting Association, and the Warwickshire Agricultural Society; and late Special Lecturer on Econonic Zoology in the University of Birmingham.

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BIRMINGHAM:
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PREFACE.

On my return to the Midlands, the scenes of my former labours on behalf of the agriculturists and horticulturists of the Midland Counties, I have been asked to continue the publication of my Annual Reports.

It is very gratifying to learn that those issued in the past have proved so helpful, and have been largely used by many writers, although the source of their information has not always been acknowledged.

After carefully considering the matter and the expense entailed in issuing such, I have decided to commence the publication of an annual report differing somewhat from the previous series.

I take this opportunity of tendering my thanks to a large number of Midland agriculturists and horticulturists for their kind expressions of appreciation of my work, and for the welcome they have extended to me on my return, and I trust that I shall for long be able to retain a confidence I greatly value and esteem, by being of some practical service to those who labour on the land.

I am indebted to the courtesy of the Controller of His Majesty's Stationery Office and the Secretary of the Board of Agriculture and Fisheries, for permission to use Figures 3, 11, 13, 13a, 20, 21, and 23 all of which are from illustrations which have appeared in the Board's leaflets.

WALTER E. COLLINGE.

59, Newhall Street,
Birmingham,
January 21st, 1911.

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FIRST REPORT

ON

ECONOMIC BIOLOGY.

"Admitting to an extent the advance of intelligent observation and the spread of entomological knowledge, it is quite clear that not only is the destruction occasioned by insects larger than ever it was, but there are insects at work in the fields which were not there in the times of our forefathers. One reason for the progressive increase of insects is that a larger supply of food encourages the proportional propagation of insects fond of and living upon it."

SIR CHARLES WHITEHEAD.

[Report on Insects Injurious to Hop Plants, 1885, p. 6]

"Even the most far-reaching problems may often be illumined and sometimes solved by observation and experiment upon a small scale. The laboratory, by its processes of bringing forces into clear relations, may in a moment disclose principles that centuries of national and world-wide experience have left unsuspected."

HON. WALTER F. FREAR.

[5th Rpt. Bd. of Comms. Agric. and For. for 1908, Hawaii, p. 88.]

INTRODUCTION.

During the year 1910, although absent from the Midlands for nearly nine months of that period, I have dealt with upwards of two thousand three hundred inquiries.

Of animal pests the three most conspicuous have been a severe attack of Whiteworms, an unusual abundance of the larvae of the Large and Small Cabbage White Butterflies, and a very serious plague of the Frit Fly.

The Pear-leaf Blister Mite has made its appearance in the Evesham, Burton, and Kidderminster districts, and the Pear Thrips has appeared in a number of Worcestershire localities.

The Woolly Aphis has spread in numerous new localities, and in many, in Worcestershire, is assuming a serious aspect.

So far as one can judge from the letters of correspondents and the inquiries received, the Black Currant Gall-Mite, Apple Sucker, Winter, March, Mottled Umber and Lackey Moths, Pear Midge, Pear Sawfly and Gooseberry Sawfly have not been anything like so numerous or serious as during the three preceding years.

Of fungus diseases the "Brown Rot" and "Black Spot" of fruit trees are by far the most serious, and unfortunately in many districts no steps are taken to control or eradicate these diseases. Familiarity has bred contempt, and growers are content with dirty, scabby, cracked, undersized fruit.

The Yellow Wart Disease of Potatoes is still amongst us, whilst the number of cases reported and the severity of the attacks of Finger-and-Toe Disease are less than I have known for many years past. The disease known as Sleepy Disease of Tomatoes has been very virulent. Throughout the whole country this disease has made great headway during the past few years, and is now perhaps the worst that tomato growers have to contend with.

My thanks are tendered to many fellow workers, particularly so to R. S. Bagnall, F.E.S., Dr. C. Börner, H. Willoughby Ellis, F.E.S., Prof. Percy Groom, Dr. L. O. Howard, George Massee, F.L.S., Robert Newstead, F.E.S., Dr. H. Schött, Dr. A. E. Shipley, F.R.S., Prof. F. Silvestri, and W. T. Wilson, F.R.C.V.S.

1.—ANIMALS INJURIOUS TO FARM AND GARDEN PRODUCE.

WHITEWORMS.

During the past year these minute worms have been forwarded to me from all parts of the Midlands, particularly from Warwickshire.

Owing to their small size they are frequently overlooked, but at the present time they are proving a most serious pest to roots and other farm crops.

Three or four species have been received, the commonest of which is *Fridericia leydigi,* Vej.

From observations made by myself during 1910, and in the opinion of many farmers, they are generally found in land deficient in lime and of a wet and sticky nature. In land badly infested, to such an extent that they were turned up by the plough in masses larger than a walnut, they almost entirely disappeared after it had been dressed with basic slag and limed.

Ground unslaked lime applied at the rate of 10 cwt. per acre has given excellent results.

MILLIPEDES.

Numerous complaints have been received respecting two species of millipedes, viz., *Blaniulus guttulatus,* Bosc., and *Polydesmus complanatus,* Linn. Both are exceedingly common species, but I have never known them in such abundance over a wide area of country as during the past year.

Potatoes, turnips, mangels, cauliflowers, beet and many other plants have suffered.

Potatoes that had been attacked by wireworms were found to contain 12 to 20 examples of *Blaniulus guttulatus.* In not a few cases which have come under my notice during 1910, the damage caused by these pests was far more serious than that occasioned by wireworms.

As I have previously pointed out, the only treatment of any practical value on a large acreage of land is the application of ground unslaked lime. In gardens, pieces of mangel or potato which have

been previously dipped in a strong solution of Paris green, should be placed amongst the plants at night and covered with a cabbage leaf. The following morning the dead millipedes should be removed, and the trap reset.

In flower beds, dig out a hole sufficiently large to contain the fist and wrist; fill with bran and cover with water. After two or three days pour on to the bran boiling water. The contents of two such holes were carefully counted after treatment, and were found to contain 2,448 and 1,793 dead millipedes respectively.

THE BULB MITE.

Rhizoglyphus echinopus, F. & R.

Considerable loss and disappointment has been occasioned by the prevalence of this mite during the past year.

In my 5th Report I mentioned that I had carried out a number of experiments on bulbs by soaking and spraying them with various fluids, such as paraffin and turpentine emulsions, sulphide of potassium, etc., but none gave satisfactory results. Many of the mites were killed, but sufficient numbers remained alive to complete the destruction of the bulb.

Since then my attention has been called to a statement made at a meeting of the Scientific Committee of the Royal Horticultural Society[1] by Mr. Saunders, which reads as follows:—

"When bulbs are thus infested with these mites nothing can be done to save them. Where only a few mites are at the base of the bulb, where the attack generally commences, they may be killed by immersing the bulbs for five minutes in water at a temperature of 115° to 120° Fahr. If some sulphide of potassium (6 oz. to the pint) be added to the water, this remedy would be all the more efficacious; indeed it is said that soaking the bulbs in this solution cold for twenty minutes will kill the mites."

I was particularly interested in the concluding statement as I had experimented largely with potassium sulphide, but never so strong as recommended in the above statement. I therefore decided to repeat my experiments using three strengths of potassium sulphide, viz.: (1) 4 oz. to 1 pint of water; (2) 6 oz. to 1 pint; and (3) 8 oz. to 1 pint.

Very badly infested bulbs were placed in the solution No. 1, and

[1] Gard. Chron., 1902 (Dec. 20), p. 465.

allowed to remain for an hour and a half; in solution No. 2 they remained for one hour; and in solution No. 3 for fifteen minutes.

Upon removing the bulbs, three in each case, two were placed in water, and the leaf scales separated and thoroughly picked to pieces, and the mites, which floated on the water, were then carefully removed and placed on glass slips and examined under a low power of the microscope, the third bulb was cultivated in order to test if the solution had in any way injured it.

In the cases 1 and 2 quite 90 per cent. of the mites were destroyed, but not more than 25 per cent. in No. 3. All three bulbs were cultivated, numbers 1 and 2 grew and flowered, but No. 3 grew for a short time only, then died.

From the above experiments I am of opinion that soaking the bulbs for an hour or more in 4 to 6 oz. of potassium sulphide mixed with 1 pint of water, will destroy by far the larger proportion of the mites. The length of time the bulbs are allowed to soak seemed to be of more importance than the actual strength of the solution, for no difference could be observed in those soaked in solution No. 1 from those in No. 2.

Since these experiments were made it has occurred to me that it might be profitable to try watering bulbs, after being treated as described above, with weaker solutions of potassium sulphide, after they have been potted or planted out.

COLLEMBOLA AS INJURIOUS INSECTS.*

In a communication read at the Oxford Meeting of the Association of Economic Biologists,[1] I drew attention to the part that various species of Collembola play as injurious insects, and instanced many cases reported by Carpenter,[2] Curtis,[3] Ormerod,[4] Murray,[5] Guthrie,[6] myself,[7] and others, where they were the direct cause of damage to roots and seeds of healthy plants, and I incidentally pointed out, in referring to the nature of the injury, that they also play an important

* Reprinted from the Journ. Econ. Entom., 1910, pp. 204, 205.

1 Journ. Econ. Biol., 1909, vol. iv, pp. 83-86.

2 Proc. Assoc. Econ. Biol., 1905, vol. i, p. 14.

3 Farm Insects, p. 432.

4 Rpt. Obs. Inj. Insects for 1904, p. 110.

5 Economic Entomology, Aptera, p. 404.

6 The Collembola of Minnesota, 1903, p. 4.

7 Rpt. on Inj. Insects for 1905, p. 10.

part in exposing different plants to the attacks of fungi by the injury they cause in wounding their surfaces.

Since then two facts have come to light which have an important bearing upon the subject.

The experiment I made I described as follows:

"During the past twelve months very careful observations have been made upon a series of common species which have fully established the fact that to orchids, numerous bulbs, beans and peas, the Collembola are distinctly injurious.

"The method adopted has been as follows:

"Shallow boxes, containing about four inches of moist soil, have been used, and into these perfectly healthy bulbs and beans have been placed. Into each box examples of different species of Collembola have been placed. The tops of the boxes in some cases were covered with a sheet of glass, and in others with a piece of wood.

"After the experiments were completed the soil and diseased bulbs were carefully examined, and apart from fungi no other pests were found, but in all cases the Collembola had increased largely in numbers."

At the time it did not occur to me to inquire "where did the fungi come from?" But since then this same soil has in part been used to pot bulbs in, and the remainder was thrown on to the garden. In the pots and in the garden where this soil was placed, there is now arising an abundant crop of different fungi.

As none of the fungi have previously been noticed in the garden and do not now occur, excepting in this restricted patch and in the pots, I think I am justified in concluding that the spores were originally introduced by the Collembola.

Dr. Buller,[1] in his recent work, states: "The gills of expanded fruit bodies are frequently visited, not only by Fungus Gnats, but also by Springtails (Collembola) . . . Some fruit bodies of *Polyporus squamosus,* which were growing on a log and had not yet become fully expanded, were infested with small black Collembola. There were as many as fifty to the square inch, and each one occupied a hymenial tube, which was just wide enough to hold it. The Springtails (genus *Achorutes*), infesting *Stropharia semiglobata,* and some other species of Agaricineae, were found to contain spores in the mid-gut," and it is well known to students of this interesting order that large numbers

[1] Researches on Fungi, London, 1909, p. 20.

are found in such habitats. Hence these minute insects, quite apart from their own depredations, may prove a source by which various plant diseases may be introduced by spores which they carry upon their bodies. This I have proved to be actually so by washing various species in water and then examining the liquid, after the removal of the insects; in such cases spores of fungi were particularly numerous.

SCALE INSECTS ATTACKING BULBS.

Ripersia terrestris (Newstead).

In February last I received from Warwickshire, hyacinth bulbs attacked by this scale insect.

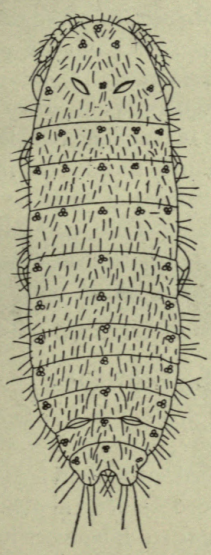

Fig. 1.

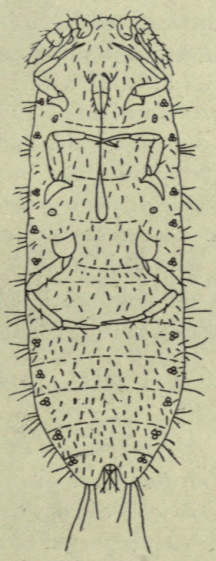

Fig. 2.

RIPERSIA TERRESTRIS (Newstead).

FIG. 1.—Dorsal view. FIG. 2.—Ventral view. (After Newstead).

It was first described by Newstead in 1895,[1] from specimens discovered near London on roots of stephanotis. The following year Mr. C. O. Waterhouse, of the British Museum (Natural History), found it on palm roots. In 1901, Mr. F. W. Burbidge called Mr.

[1] Entom. Mon. Mag., 1895, vol. iv, pp. 213, 214, figs. 1-5.

Newstead's attention to it "attacking the roots of warm greenhouse ferns in Co. Kildare, Ireland."

Mr. Newstead describes it[1] as living "chiefly upon the terminal or outside roots of pot plants, where it secretes or spins patches of pure white fibrous wax, similar to that made by the common mealy bugs, but less compact. In these retreats the insects live and lay their eggs."

He continues: "The origin of this pest remains to be discovered. In all probability it is an indigenous species, and may have been introduced in the potting material. But as the insect has not been met with outside it may have been introduced on the roots of imported plants.

Mr. Newstead recommended the following treatment: (1) Not to "turn the infested plants out of the pots while in the conservatory, as a strong current of air may sometimes carry away a patch of the woolly material, and with it the eggs or females.

(2) Infested plants should, at the proper season, have all the soil removed from the roots and thoroughly washed in two lots of clean water. The pots from the infested plants should be immersed in scalding water or heated to destroy any adhering eggs or insects."

In the case recorded above, the plants were carefully removed from their pots and washed in water, and repotted in fresh pots and soil. The old soil was burnt, and the pots scalded out. No further trouble has been noticed.

THE TURNIP GALL WEEVIL.

Ceuthorhynchus sulcicollis, Gyll.

In 1906 the larvae of this beetle proved very troublesome in Worcester, Warwick, Shropshire, and Stafford; since then but very few cases have been reported to me. During 1910, however, it reappeared and caused a large amount of damage to turnips. I am therefore repeating its life-history and the preventive and remedial measures previously given.

Life-History.

The female deposits her eggs on the roots of cabbages and turnips, or with her proboscis excavates small holes, into each of which she usually places a single egg. In about ten days the larvae hatch

[1] Monog. Coccidae Brit. Isles, 1901, vol. i, p. 63.

out, as short, thick, legless, yellowish-white maggots, and around each a small swelling arises, known as a gall. Within this the larva passes the winter, and when full-fed it leaves the gall, and in the earth makes a cocoon consisting of an internal gummy-like substance, surrounded by particles of earth. It remains in the pupal stage about eight weeks.

In the early part of the year this life-cycle takes place on such cruciferous plants as Charlock, and later on the cabbage and turnip.

Preventive and Remedial Measures.

Charlock and all cruciferous weeds should be destroyed.

All infected cabbage stalks should be burnt, instead of being allowed to rot in heaps, or buried in the ground. In both cases the propagation of this pest is favoured, for the larvae make their way from the galls into the earth, where they pupate, and later the beetles emerge ready to infect a new crop.

THE TURNIP FLEA BEETLE.

Phyllotreta nemorum, Linn.

The Turnip "Flea" or "Fly," the popular names of this destructive insect, has been forwarded by numerous correspondents with reference to damage done to turnips, cabbage, kale, etc.

The life-history has long been familiar to agriculturists, having

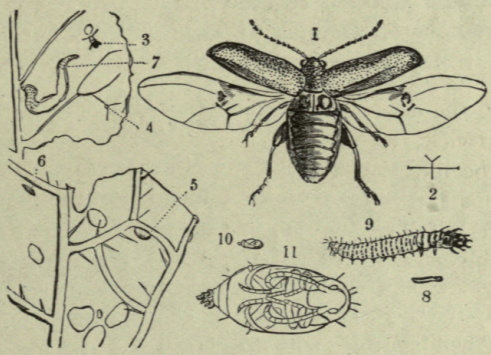

Fig. 3.—The Turnip Flea Beetle.

1.—Beetle, much enlarged. 2.—Natural length and wing expanse. 3.—Beetle, natural size. 4, 5.—Egg, natural size and magnified. 6, 7.—Mine and cuticle eaten away by larva. 8, 9.—Larva, natural size and magnified. 10, 11.—Pupa, natural size and magnified.

been described in detail by Keux,[1] and later by Curtis; in spite of this fact, however, we have made little progress in controlling this insect. Climatic conditions undoubtedly have much to do with its increase.

I have carefully studied experiments made on spraying the plants and on soaking the soil with different substances, but none have proved successful. Clean cultivation and the destruction of all cruciferous weeds must prove beneficial if generally carried out.

These small beetles have considerable powers of flight, and observation shows that they fly against the prevailing wind, undoubtedly being attracted by the smell of the germinating seed. Numerous experiments have been made to ward off the insects by a counter odourant, but these, so far, have only proved partially successful. Any experiments, to be of practical value, must be carried out on a considerable acreage, and, as yet this has not been done. Plot and garden experiments, in a case such as this, are useless to the farmer.

THE LARGE CABBAGE WHITE BUTTERFLY.

Pieris brassicae, Linn.

The years 1909 and 1910 were both characterized by a plague of the Large Cabbage White Butterfly, that has not been equalled for very many years back, in consequence of which, vegetable gardens and small holdings suffered severely.

The life-history is familiar to most people, but in view of the recent plague it may be well to repeat it.

Life-History.

The insects appear towards the end of April, and the females lay their eggs in clusters usually on the underside of the leaves. In colour they are lemon-yellow, cone-like, or sugar-loaf shaped, and marked by fifteen to seventeen longitudinal ribs. The larvae hatch out in from two to ten days, according to the season and temperature.

The newly-hatched caterpillar is about 2 mm. long, and green or brownish-green spotted with black; there are four moults, after which they vary from a bluish-green to yellow, with black spots and

[1] Trans. Entom. Soc. Lond., vol. ii, p. 24.

warts and yellow legs. They reach maturity in from four to six weeks.

The pupa is fixed to walls of outhouses, fences, the plants, stones, etc. It is variable in colour, and can withstand great cold.

Many of the caterpillars examined in 1910 were parasitized by a small hymenopterous fly, *Microgaster glomeratus*, Linn.

Preventive and Remedial Measures.

Cabbages and other plants may be sprinkled with finely-ground lime, or if ready to cut sprayed with salt and water.

All chrysalids should be destroyed. A few days rain will kill thousands of the caterpillars; in its absence a good drenching of water with a garden hose will do much good.

THE GARDEN SWIFT MOTH.

Hepialus lupulinus, Linn.

The caterpillars of this moth are frequently the cause of considerable damage to bulbaceous plants. I have numerous records made during 1910 of their attacks on paeonies, also potatoes and winter beans.

Life-History.

The perfect insects appear towards the end of May, and may be seen rapidly darting about over hedgerows, grass, etc., at dusk as late as the end of July.

The eggs are dropped on the ground by the female as she flies, and hatch in from nine to twelve days.

Fig. 4.—Larva of Garden Swift Moth, attacked by fungus, *Cordyceps militaris*.

On emerging from the egg the young caterpillars make their way into the soil, and at once commence feeding upon the roots of various plants, and continue to do so until the following April. In mild winters they do the most damage, continued extreme cold driving them into the deeper soil, where I have taken them at a depth of 18 inches or more from the surface.

The full-grown caterpillar measures just over an inch and a half in length. In colour they are a dull creamy white, sometimes slightly tinged with green; the head a light brown, and marked with a prominent Y-shaped mark.

Pupation takes place towards the end of April or early in May. They are usually enclosed in a loosely-made silken cocoon, to which are attached particles of soil, or they may be free.

The perfect insects, as pointed out above, appear towards the end of May, and are extremely variable in colour.

From Sutton Coldfield I have received on two occasions examples of the larvae attacked by a parasitic fungus known as *Cordyceps militaris*, Linn. These so-called "Vegetable Caterpillars" were particuarly common in this locality some few years ago.

Preventive and Remedial Measures.

The best results I know of have been obtained by dressing the ground in the early autumn with ground unslaked lime. Soot, and various soil insecticides and fumigants will also destroy the larvae.

Constant hoeing will destroy many, but as they frequently make their way some considerable distance below the surface, it is only a partial remedy.

CRANE FLY LARVAE ATTACKING BULBS.

The different species of Crane Fly larvae (Leather Jackets) are well known as pests to root and cereal crops, but I have not hitherto met with them damaging bulbs until this past season.

A Derbyshire grower forwarded me in April last a large number of tulip bulbs seriously damaged by the larvae of the Spotted Crane Fly, *Pachyrhina maculosa*, Meigen. Hundreds of bulbs had been more or less destroyed.

Upon examination large numbers of the larvae were found to be feeding upon the bulbs, having eaten holes into the tissue of from half to three quarters of an inch in length. Four to six larvae were taken from each bulb.

I subsequently learnt that quite close to where the bulbs had been planted there was a hawthorn hedge, and a considerable amount of wild grasses and other weeds had been allowed to flourish there, offering an admirable site for the flies to deposit their eggs.

Life-History.

This is pre-eminently a garden and hedge loving species, although also found in fields and meadows. Its life-history was first worked out by Curtis.[1]

The eggs are oval, spoon-shaped, and jet black. The larvae are of an earthy colour, very wrinkled, and about three-quarters of an inch long. They pupate early in the spring, the pupae being a golden-brown colour and slightly narrower than the larvae, though about the same length.

Curtis refers to them as eating "off trusses of the strawberry flowers close to the crown . . . the first week in May they were not uncommon amongst the roots of the lilac and under tufts of grass; they were also destroying the strawberry and raspberry plants as well as the carrots; on the 28th of the same month I observed some recently-transplanted lettuces drooping, and on examination I found the roots separated from the crown a little below the surface, and close by these grubs. . . . At the end of July they were eating the roots of dahlias, carnations, and various flowers, and on the 7th of August they were observed infesting some potato ground with the larvae of *T. oleracea;* after which I lost sight of them."

Preventive and Remedial Measures.

Amongst the birds that feed upon the larvae must be mentioned the starling, lapwing, pheasant, various gulls, and the rook. All the species of Crane Flies have increased enormously with the decrease of the lapwing, and the same holds true with regard to wireworms and other soil pests.

As preventive measures, all rough herbage should be kept down during the autumn, the flies often utilising it for depositing their eggs on; heavy rolling pasture land, when the flies are noticed, kills large numbers; attention to drainage is also important, as the flies prefer damp land.

Sand saturated with paraffin and scattered along hedgerows, etc., will act as a deterrent to egg laying. Ground unslaked lime and gas lime will destroy many of the larvae.

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[1] Farm Insects, 1883, p. 449.

THE MARGUERITE FLY.

Napomyza lateralis, Fall.

In common with many other species of leaf-mining flies, this species has been the source of considerable injury to marguerites during the past year.

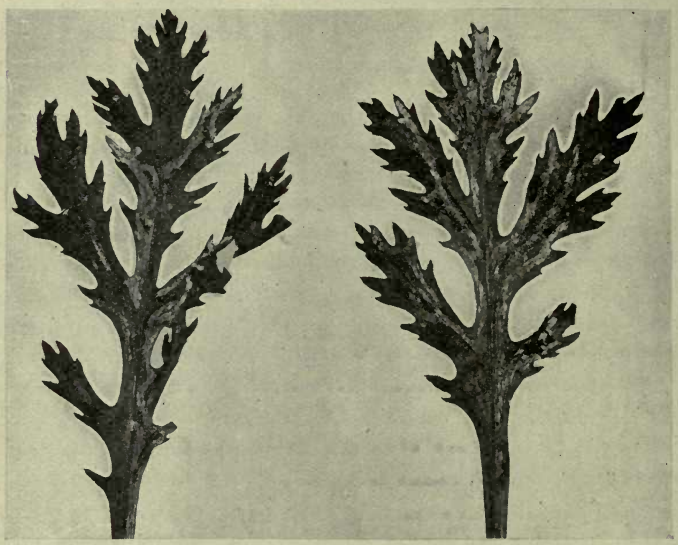

FIG. 5.—LEAVES OF MARQUERITE, attacked by Fly.

It is a troublesome pest to control, but spraying the young plants with paraffin emulsion has given excellent results.

All plants that are badly attacked should be burnt, and others that are less so should be carefully examined, and the diseased leaves picked off and burnt.

THE FRIT FLY.

Oscinus frit, Linn.

Not for very many years past has this insect been such a serious pest as during 1910; not only was this so in the Midland Counties, but generally throughout the country, and oats and barley have suffered considerably.

I have previously dealt with the life-history,[1] but in view of the prominence it has assumed during the past season it may well be repeated.

Life-History.

The flies appear from April to May, the females depositing their eggs on the leaves of the young plants. On hatching, the larva—which is a small, fleshy, legless maggot—makes its way to the lower part of the plant, and thence into the centre of the stem, subsequently pupating there. About the middle of July the second brood of flies appears; and the females lay their eggs on various grasses, and, if sufficiently developed, in the ears of oats and barley.

The third brood of flies appears in August and September, the females depositing their eggs on different wild grasses, and the flies from this generation issuing from the puparia in the following spring.

Preventive and Remedial Measures.

The importance of early sowing will at once be fully recognized, and the advantage of a dressing of artificials to stimulate growth.

Wherever an attack has been noticed the previous season, the land should be ploughed with a skim-coulter attached; or deep ploughing resorted to.

Oats and barley should be planted the next season as far away as possible from areas previously affected.

All wild grasses should be destroyed.

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[1] 5th Report on Inj. Insects, 1908, p. 43.

2.—ANIMALS INJURIOUS TO FRUIT TREES.

THE PEAR-LEAF BLISTER MITE.

Eriophyes piri (Pagenst.), Nal.

This pest has been on the increase for some years past, and is still spreading annually over a wider area.

Unlike most species of *Eriophyes*, this one feeds upon a variety of plants of the same Natural Order. Prof. Nalepa records it on Pear, Apple, White Beam Tree (*Pyrus aria*), Wild Service Tree (*Pyrus terminalis*), Rowan (*Pyrus aucuparia*), and *Cotoneaster vulgaris*.

The mite attacks both leaves and developing fruits. In the early spring the mites leave their winter quarters, viz., beneath the scales of the last year's buds, and gall the young leaves; here the females lay their eggs, and fresh broods arise, which spread over, usually, the leaves of the terminal twigs and form fresh blisters. On the first approach of autumn and before the leaves fall, the mites repair to their winter quarters. Leaves examined in September and October were quite free from mites, although I have found them present as late as the end of September.

Preventive and Remedial Measures.

A number of experiments have been made with a view to testing the value of spraying with (1) paraffin emulsion, and (2) a solution of potassium sulphide.

1. Paraffin Emulsion.—The trees were sprayed three times in the spring of 1909, but were quite as badly attacked in 1910 as previously.

2. Potassium Sulphide Solution.—Two badly-attacked trees were sprayed twice in the spring of 1910, and have materially benefited. The first spraying was applied just as the trees were coming into leaf, and the second about a fortnight later. Although in 1909 there was scarcely a leaf that was not blistered, it was quite the exception to find one during 1910.

The value of sulphur is now so generally recognised as an acaricide, that I fully expected that a solution of potassium sulphide would be effective, and this has proved to be the case.

Winter spraying with caustic soda and other winter washes does not seem to have any effect upon this pest so far as my observations go, but I believe that a fluid consisting of—

Potassium Sulphide		...	...	$1\frac{1}{2}$ lbs.
Soft Soap	...	...	...	$1\frac{1}{2}$ lbs.
Lime	...	...	...	$1\frac{1}{2}$ lbs.
Water	...	...	...	50 gallons.

sprayed early in September, would destroy large numbers of the mites as they leave the leaves and migrate to their winter quarters.

All nursery stock should be fumigated with hydrocyanic acid gas, whilst in a dormant condition.

THE BLACK CURRANT GALL-MITE.

Eriophyes ribis (Nalepa).

Judging from the letters I still continue to receive from all parts of the British Isles, the results obtained by the application of lime and sulphur has exceeded my most sanguine expectations.

The remedy has been scoffed at by certain individuals, no doubt owing to its simplicity, but no such childish actions can alter the fact that whereas five years ago the cultivation of Black Currants was despaired of in the United Kingdom, now large quantities are being cultivated free from "Big-bud."

The remedy has, of course, failed where it has been misapplied, or where the quantities have not been carefully measured, but where the work has been properly done it has been successful in 90 per cent. of cases.

As the earlier Reports are out of print, I again repeat the method.

Mix one part of ground unslaked lime with four parts of sulphur and dust on the bushes, when the dew is on them, as soon as the leaves have opened. A fortnight or so later dust again with one part of lime to eight parts of sulphur, and again at a similar interval with sulphur only.

RED "SPIDER" ON APPLE TREES.

Numerous complaints have been received from Worcestershire fruit growers of the extraordinary prevalence of Red "Spider" on Apple trees. In some cases gooseberry bushes were growing between the trees, but in others this was not so.

Considerable losses were occasioned in not a few cases.

The following simple sprayfluid was found very effective, indeed, I know of nothing better for the destruction of mites. In America it has proved successful for treating the Brown Mite (*Bryobia pratensis,* Garman) and the Red "Spider" (*Tetranychus bimaculatus,* Harvey), when nicotine and other substances have failed.

Flowers of Sulphur	16 lbs.
Soft Soap	½ lb.
Water	50 gallons.

The trees should be sprayed as soon as ever any injury is noticed. On gooseberry bushes this sprayfluid has proved equally effective.

PEAR THRIPS.

Euthrips pyri, Daniel.

During 1909 this insect appeared in the Evesham district in Plum blossom in large numbers, and to a smaller extent during 1910.

It attacks nearly all varieties of deciduous fruits, and is certainly one of the most destructive species of its order. To what extent it is distributed in this country it is difficult to say. The Evesham record is the first for this country, and, curious to say, although countless specimens had been examined in California, the male had never been discovered until found by Mr. R. S. Bagnall, the well-known authority, amongst some examples I sent him collected at Evesham.[1]

The life-history has been very carefully worked out by Moulton,[2] and a summary of his account is here given.

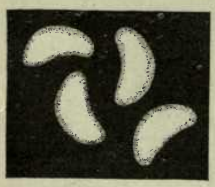

FIG. 6.—THE PEAR THRIPS.
Eggs. Highly magnified. (After Moulton).

The egg is bean-shaped (Fig. 6), light-coloured, and almost transparent. It measures about 0·33 mm. in length.

After making an incision with the mouth parts, the insect moves forward, lowers and inserts the ovipositor, and by moving the tiny saws she makes a deep incision in the plant tissues. Whilst the ovipositor is still deeply set in the plant, an egg is conducted through the cavity between the plates and deposited beneath the epidermis. The ovipositor is then withdrawn, and the egg is left deeply embedded within the plant.

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[1] Journ. Econ. Biol., 1909, vol. iv, p. 37.

[2] U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. i, 1909.

The eggs are deposited on the newly-exposed blossoms, stems, and leaf petioles, and later the midribs and veins of the underside of the leaves.

The period of egg-laying extends over several weeks. The egg stage lasts, approximately, four days.

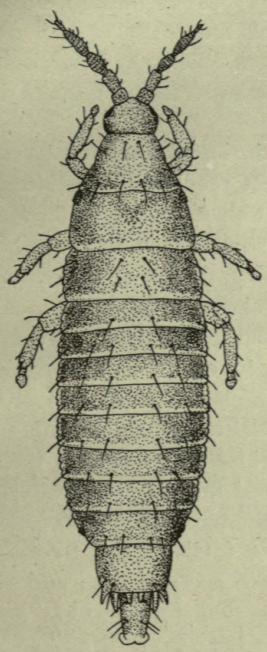

Fig. 7.

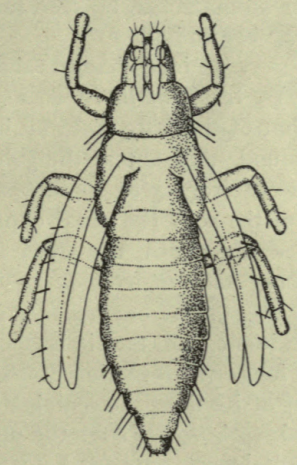

Fig. 8.

THE PEAR THRIPS.

FIG. 7.—Larva. Much enlarged. FIG. 8.—Nymph or pupa. Much enlarged. (After Moulton).

"*The Larva.*—It is interesting to watch, with the aid of a strong lens, a young thrips issuing from the egg. The tiny incision in the stem of a blossom or leaf shows where an egg has been placed, and the enlarging egg within, causing a swelling in the plant tissue, at the summit of which is the incision, indicates that the insect is about ready to emerge. The first sign of life is the appearance, pushing out from the incision, of the head, with its bright red eyes. Little by little, and swaying backward and forward, the larva forces itself out until about one-half of the body is exposed, when first the antennae,

and then one by one the pairs of legs are made free from their resting position against the body. Swaying backward and forward, with legs and antennae waving frantically about, the insect pushes out of the egg cavity almost to its full length, whereupon, leaning forward, it eagerly takes a hold with its newly-formed feet, and, with a final effort, pulls itself free, and walks rapidly away. From four to ten minutes are required for the insect to free itself from the egg. The young insect is almost transparent, and the green chlorophyll particles taken into the stomach can be seen through the body wall. Growth is rapid from the beginning.

A very decided change takes place during the second larval stage (Fig. 7). In about three weeks the insect reaches a size often larger than that of the fully matured insect. It then ceases to feed, falls to the ground, and enters the ground by some crack or wormhole. It goes down from 3 to 10 inches, according to the structure and condition of the soil, the usual depth being about 4 inches. Upon reaching a secure depth, the larva hollows out for itself a tiny spherical or oblong cell, or it finds an exceedingly small natural cavity, and shapes this for its convenience. The completed chamber has a hard, smooth inner wall, and it is about one-twelfth of an inch long, or just a little longer than the insect itself. The insect here spends the greater portion of its life. It remains for several months a quiescent, non-food-taking larva. Later the pupal changes are undergone, and lastly the adult insect appears before it issues forth to the tree. Larvae collected from the ground on August 28th were active, and, strange to say, green chlorophyll matter, undigested food, which had been taken into the stomach several months before, was still present in their bodies. The insects are scattered through the soil from near the trunk to several feet from the tree."

The Nymph or Pupa.—Mr. Moulton has not been able to determine how long the nymph stage (Fig. 8) lasts, but it evidently extends over several weeks. Nymphs in all stages of development were collected during May and at intervals until the following February, but they are most common during December, January, and February. Mr. Moulton has gathered nymphs from the ground early in May, but it is difficult to explain their presence there so early in the spring. It hardly seems possible that these were the still immature forms of the previous year, for by this time all adult thrips have left the trees. These nymphs were taken along with the larvae, which had just entered the ground, and it might seem that they were hurrying through to

produce a second generation; but to his certain knowledge adults of a second generation did not appear on the trees. The nymph is active at all times. Wings develop from mere buds to long sacs, which project backward along the sides of the body, and eventually reach beyond the tip of the abdomen.

The Adult.—"The adult thrips (Fig. 9) remain in the pupal stage chamber for days, and it may even be weeks before they issue forth to take up active life. How individual thrips force their way through the several inches of earth which lies above them is still a question. They come out, it seems, only after the ground has been thoroughly softened by rains, and it is evident, too, that they depend largely on the natural openings. They cannot possibly use the backwardly bent mouth cone as a means of boring or biting their way out. They have several groups of spines and certain angular edges on the sides of the abdominal segments, however, which might be used in forcing a way through the soft soil. They also possess roughened scoop-like structures—parts of the chitinous, hoof-like shell of the feet—which undoubtedly are used for digging."

FIG. 9.—THE PEAR THRIPS. Head and prothorax from side, to show mouth-parts. Much enlarged. (After Moulton).

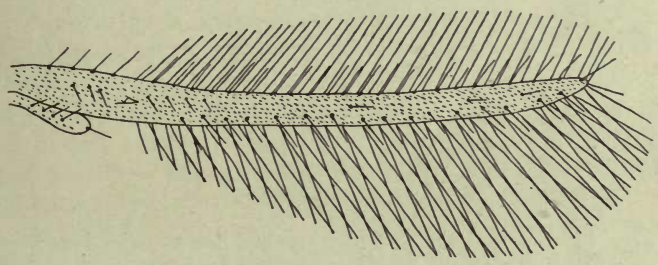

FIG. 10.—THE PEAR THRIPS. Fore wing of female. Much enlarged. (After Moulton).

PREVENTIVE AND REMEDIAL MEASURES.

Seeing that this insect spends most of its life in the ground, and is well protected during the short period it is on the trees, spraying is of little use.

Deeply turning over the surface soil wherever possible would seem to be the most practical remedy.

MEALY BUG on VINES.

A Warwickshire correspondent reported a very serious attack of Mealy Bug on Vines, the particular species being *Dactylopius longispinus* (Targ.-Tozz.).

When inspected the stem, branches, and roots were covered with the insect in various stages; indeed, I have never seen a worse attack, although it is a common vine pest in the Midlands, and frequently forwarded by nurserymen, etc.

The method adopted in this case was as follows:—

A tin of soft soap and paraffin (Price's) was mixed with a little water to the consistency of paint, and the whole of three vines were painted over with a stiff paint brush. The roots were treated with the same material, further diluted, and at a later date the whole of the plants were well sprayed with a still further dilution of the same material.

Although the trouble, so I was informed, had existed "for some years on a small scale, it seemed to break out and run riot" with the commencement of 1910, but happily nothing further has been seen of the pest, and the house up to the present time remains quite free.

THE CHERRY BLACK FLY.

Myzus cerasi, Fabr.

The black aphis of the cherry is a particularly serious pest to wall fruit, and it was recorded on such trees from various localities during the past year.

Life-History.

Early in the spring, on the lower leaves, wingless viviparous females appear, having hatched from eggs laid the previous autumn. These soon give birth to young lice, which develop into wingless viviparous females, which quickly spread over the tree, feeding on the leaves from their undersides. The infested leaves curl up and many die, particularly is this so in dry weather. This continues until July, when many change to olive green pupae with yellowish wing cases. Later these develop into winged viviparous females, and for a short time they remain on the tree, suddenly deserting it. Where they go

to is not known, but it seems probable that they ultimately return and give rise to the oviparous form, the female of which is wingless, and deposits her eggs, one to four, on the lower branches, trunk, or suckers.

Preventive and Remedial Measures.

Autumnal and Spring spraying with an aphicide should be carried out, the latter can with advantage be repeated, allowing a week between the two sprayings.

Winter spraying is important in keeping the stem and branches clean. All suckers should be removed before the spring and burnt.

THE WOOLLY APHIS.

Schizoneura lanigera, Hausm.

I have frequently referred to the increase and neglect of this pest in the Midland Counties, and at the present moment it would appear as if it were going to become one of the most serious that the fruit-grower has to contend with.

Most fruit-growers are fully alive to the seriousness of the situation, and know full well how foolish it is to neglect even the first appearances, but unfortunately in private gardens it is allowed to breed unmolested. The result is that the fruit-grower is put to great expense in spraying to check, or control, the pest, and is little better off the following year, for there is a constant supply invading his orchard.

I am sure if a determined attempt were made by owners of fruit trees to give no quarter to this insect they would be benefiting themselves, and at the same time conferring a great benefit upon the commercial grower, who at present is severely handicapped.

Fruit-growers and others should demand that before being sent out, all nursery stock should be fumigated with potassium cyanide.

As I have elsewhere pointed out, the direct injury caused by these insects is by draining the vitality of the tree. One has only to inspect a badly-attacked tree to realise what an enormous drain there must be upon it. A badly-attacked standard apple tree must contain many millions of insects.

Wherever punctures are made by the insects on young wood, an

abnormal growth of tissue takes place, having the appearance of rounded or irregular swellings.

Later, many of these gall-like lumps split (and are often stated to be "Canker"), and it is in these splittings that fungi and other pests find lodgement. On old and neglected trees the growths of fungi are particularly prominent.

From what has already been said, it will be readily seen that the Woolly Aphis is a most destructive insect, and one that is difficult to eradicate.

Preventive and Remedial Measures.

So long as people are allowed to neglect their orchards, or even a few trees, this pest will be with us, and can only be controlled by exercising most drastic treatment.

Thorough winter spraying ensuring the complete cleansing of the affected trees, and the fumigation of the roots, followed by the usual spring spraying, is most essential.

If this treatment is persisted in I think the pest will be held in check, but it is most important that the roots of the trees should be treated as well as the branches.

Spraying in Autumn is of little, if any, use, for as fast as the trees are cleansed, winged females from trees in other orchards re-infest them.

Much in the way of prevention can be done by care in smearing over cut branches, and at points of grafting, also in exercising a little care to see that the trees are not bruised. Should this occur, the bruises should be coated over with creosote or some grafting paste.

THE BLOSSOM BEETLE.

Meligethes aeneus, Fabr.

Many Worcestershire growers have forwarded Apple and Pear blossoms supposed to have been attacked by a small beetle, of which large numbers were invariably found in injured blossoms.

This insect has long been known to me as inhabiting apple and pear blossom, but it does no damage whatever. It has been recorded and reported upon by Miss Ormerod and other writers.

The damage to the pear blossoms in many cases was due to the Pear Thrips, and that in the apple to Apple Sucker, Winter Moth larvae, etc.

THE CLOUDED DRAB MOTH.

Taeniocampa incerta, Hufn.

Under the name of *Taeniocampa instabilis,* I recorded the larvae of this insect as damaging roses in a Warwickshire garden in 1904, and again in 1905,[1] in which year it was also found attacking dahlias.[2] Taschenberg[3] mentions it as feeding upon both elm and lime.

During the past year I have received it from Worcester, where it was attacking apples. Fruits slightly less than a walnut in size were completely ruined, having large holes in the sides quite half an inch in depth. In this case little damage was noticed on the leaves, a few were eaten, but generally speaking the fruit suffered most.

THE GREEN PUG MOTH.

Chloroclystis rectangulata (Linn.).

The larvae of this moth have been forwarded from all parts of the country during the past season. In many cases it was sent under the belief that it was the larva of the Winter Moth (*Cheimatobia brumata,* Linn.).

In Devonshire and Somersetshire it has been extremely plentiful, and done quite as much damage as the Winter Moth.

Life-History.

The life-history is only imperfectly known. What I believe to be the eggs of this species were first noticed on cherry twigs in July. They remain on the trees all winter. The moths appear early in May. The first larvae were received from Devonshire on May 9th, but these must have been hatched some days. They vary from an apple-green to pale green, with an irregular rusty-red or reddish-purple line running down the mid-dorsal line. Laterally there is a yellowish-green line in young examples, but this becomes very indistinct later.

The larvae became full-fed by the last week in June and fell to the ground, where they pupated, forming an earthen cocoon.

Carpenter,[4] who has recorded this species from Co. Fermanagh, Ireland, mentions it as being found on apple branches which were infested with Winter Moth caterpillars. He refers to them feeding on Apple and Pear blossoms.

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[1] 2nd Rpt. Inj. Insects, 1905, p. 59.
[2] 3rd. Rpt. Inj. Insects, 1906, p. 34.
[3] Praktische Insekten-kunde. Die Schmetterlinge. 1880, Th. iii, pp. 137, 138.
[4] Econ. Proc. R. Dublin Soc., 1906, vol. i, p. 331.

THE BUD MOTH.

Hedya ocellana, Fabr.

This is a common insect in Midland orchards, but it has not come under my notice in sufficient numbers until this last year to warrant it being described as a pest.

Early in 1910 it was received from Worcester, Hereford, and Gloucester.

The life-history has been worked out by Kollar,[1] Fletcher,[2] and Slingerland,[3] and was previously known to me only from their accounts. During the year I have been able to observe it myself.

The moths appear towards the end of May or early in June, and the female deposits her eggs either singly or in clusters upon the upper sides of the leaves. It is stated by Kollar that the eggs are deposited "sometimes on the fruit-buds, and sometimes on the leaf-buds only, where they remain all winter, and only come to life the next spring"; but both Fletcher and Slingerland state that the eggs hatch in late summer or early autumn, and that they retain the larvae state through the winter. This agrees with my own observations, but Theobald[4] states that he has "found such small lavae in spring," that he is inclined to fancy that Kollar's statement is also correct.

The eggs have a gummy appearance, round and flattened, and overlap one another. The larvae hatch out in from seven to ten days, and at once commence to feed upon the buds and lower surface of the leaves. Attached to the mid-rib they form little silken tubes, or spin a fine webbing extending from the mid-rib to the edge of the leaf beneath which they feed. As winter approaches they make their way to the axils of the buds, and spin silken coverings, to which bits of dirt, algae, etc., are attached, and winter therein. With the swelling of the buds they leave their winter quarters, and make their way into the buds. As the leaves and blossoms develop they bind them together with a silky web, and ultimately pupate amongst the dead leaves.

Preventive and Remedial Measures.

Spraying in the late summer with arsenate of lead will destroy many of the young caterpillars. This should be repeated in the spring.

Winter spraying does not seem to destroy this pest.

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[1] A Treatise on Insects, Eng. trans., 1840, p. 234.
[2] Rpt. Dept. Agric. Canada for 1891, p. 195.
[3] Agric. Exp. Stat. Cornell Univ., Div. Entom., Bull. 107, 1896.
[4] Insect Pests of Fruit, 1909, p. 84.

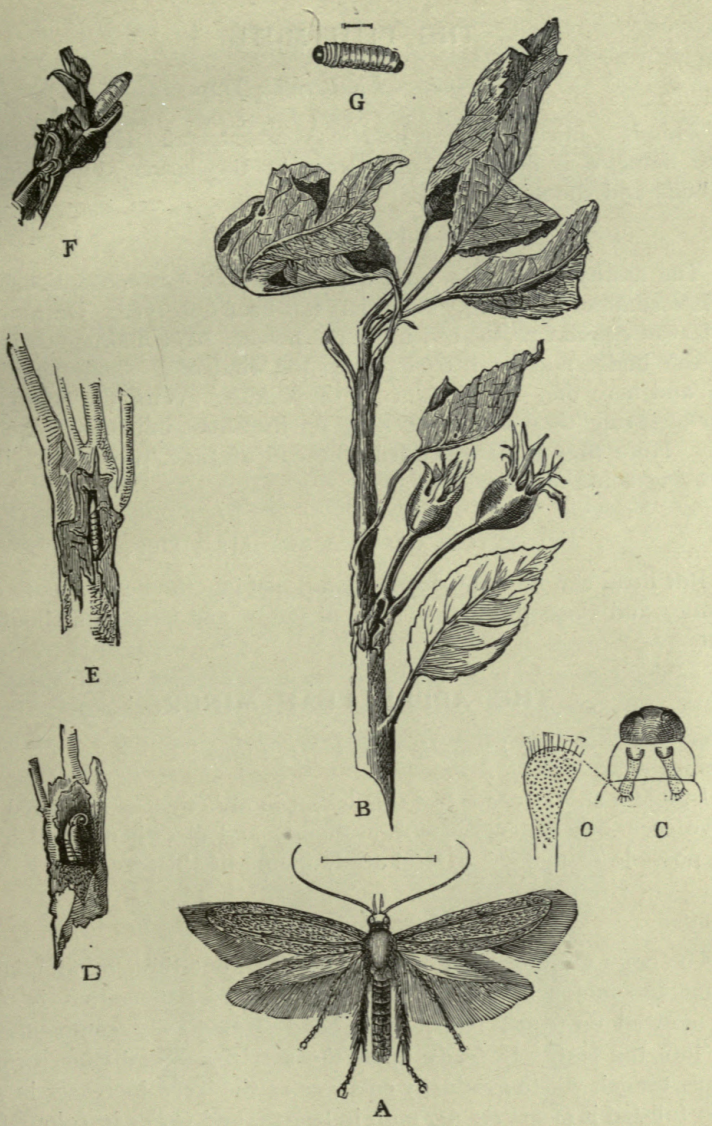

FIG. 7.—THE PITH MOTH.

A.—The Moth. B.—Attacked apple-shoot. C.—Processes on pupa. D.—Pupa, *in situ*. E.—Larva, *in situ*. F.—Larva in opened bud (enlarged). G.—Larva (enlarged).

THE PITH MOTH.

Blastodacna hellerella, Dup.

This is a fairly common pest in Worcester and Hereford, where much damage is done to apple trees by the larvae tunnelling into the buds and shoots.

Life-History.

The moths appear in July, and the larvae become noticeable in the late summer. The egg stage has not been observed. On hatching the larvae commence to feed upon the leaves, next making their way into the buds, and later boring into the rind of a shoot near to a bud, and here they remain during the winter. With the commencement of spring they start tunnelling up the shoot until they reach the apex. Here they pupate towards the end of June, the perfect insect appearing some three weeks later.

Preventive and Remedial Measures.

But little can be done beyond hand-picking the dead shoots early in June, and close pruning. Both pickings and prunings should be burnt.

THE APPLE LEAF MINER.

Lyonetia clerckella, Linn.

I gave a short account of this insect in my 5th Report, since then I have seen other cases in the Midlands and elsewhere, and it has been possible to make a careful study of the life-history.

Life-History.

The eggs are deposited one on each leaf, but three or four larvae are not uncommon in a single leaf. The larva hatches out in April (first noticed on April 26th, 1910), and immediately commences to bore into the leaf. It feeds upon the soft tissue and thus forms a sinuous tunnel, which gradually enlarges as the larva increases in size. When full-fed it measures 6-7 mm. in length, and varies in colour from pale to deep apple-green. The duration of the larval period varies considerably, some being mature in thirty days, whilst others do not pupate until forty.

When full-fed the larva eats its way out of the tunnel and crawls upon the leaf, and after four to six hours commences to form a white silky cocoon, usually on the lower side of the leaf. The cocoon is left open at each end. The pupal stage averages about twelve days, but is variable. Three or four broods occur in a year. During the winter months the moths hybernate in crevices, amongst rubbish, etc., and in wooden sheds, etc.

Preventive and Remedial Measures.

As will be gathered from the life-history, this is a difficult pest to attack. Hand-picking and burning the attacked leaves, whilst successful, is a somewhat drastic measure, and practicable where only one or two trees are attacked.

Early spraying with paraffin emulsion, with plenty of soap in, will deter the moths from depositing their eggs on the leaves.

Where espaliers are grown, dead leaves are often left amongst the branches, and thus afford winter quarters; these should be removed and burnt.

THE PEAR MIDGE.

Diplosis pyrivora, Riley.

Very few cases have been reported of this pest during 1910. Since I wrote of it in 1904,[1] it has considerably decreased in the Midland Counties. I am now quite convinced that it can easily be held in check by the measures I there recommended, viz., turning over the

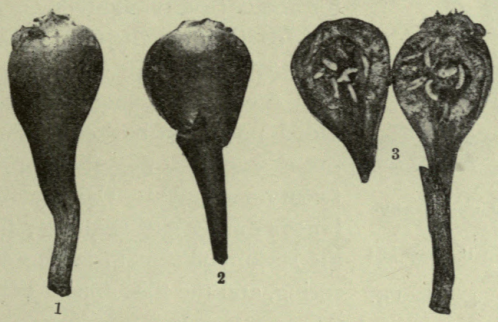

Fig. 12.—The Pear Midge.
1 and 2.—Distorted pears containing larvae. 3.—Section showing larvae *in situ*.

[1] 2nd Rpt. on Inj. Insects, 1905, p. 49.

ground beneath the trees in the winter, and rolling it in the early spring. By this means the pupae are deeply buried, while the rolling hardens and cakes the surface, thereby preventing any few pupae which may have been left near the surface from making their way through.

I know of a case where this troublesome pest has been effectually eradicated by turning fowls into the orchard in the months of June and July. A very bad attack was experienced in 1909, but nothing has been seen of the insects during 1910.

Spraying for a pest of this kind is wasteful and largely ineffective, as also the scattering of kainit on the surface of the ground.

THE GOOSEBERRY SAWFLY.

Nematus ribesii, Scop.

A few cases have been reported upon where the larvae of this insect have occasioned a large amount of damage.

Life-History.

The eggs are laid on the underside of the leaves, and the larvae hatch out in from six to eight days. At first they are very small, almost white, with a few black spots anteriorly, and a black head. There are four moults, and after the first one the caterpillars are greener in colour, and the black spots more numerous. They continue active for about twenty-eight days. On becoming full-fed they usually fall to the ground, enter the earth, and there spin brownish-coloured, oval cocoons. Sometimes the cocoons are found upon the bushes themselves. From these cocoons the flies appear in about twenty-one days. Usually there are three broods during the summer; the cocoons of the last brood remain in the earth until the spring, and the flies appear early in April.

Fig. 13.—The Gooseberry Sawfly.
1 and 2.—Larva in the two last stages.
3.—The Cocoon. 4.—The Fly.

Preventive and Remedial Measures.

The pupae may easily be destroyed by turning over the soil beneath the bushes in the early spring, or in the case of a few bushes

only, the surface soil can be removed to the depth of a few inches and deeply buried.

Hand-picking the leaves which have eggs or young caterpillars on soon reduces the number.

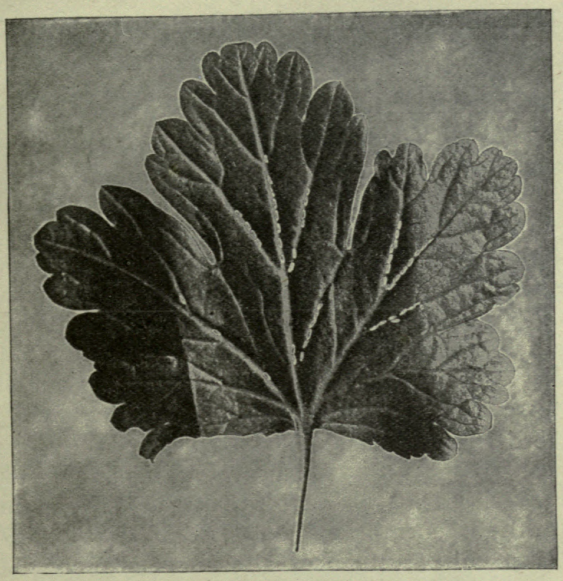

FIG. 13a.—THE GOOSEBERRY SAWFLY.
Eggs on leaf, natural size.

Dusting the bushes with flowers of sulphur when the dew is on the leaves has proved valuable.

For spraying, a mixture of 6 lbs. of soft soap, and 3 to 4 gallons of paraffin to 100 gallons of water, has given good results.

3.—ANIMALS INJURIOUS TO FOREST AND ORNAMENTAL TREES.

THE LARCH AND SPRUCE CHERMES.

Chermes abietis, Linn.

I gave an account of this insect in my 3rd Report, together with the recommendations of Mr. E. R. Burdon,[1] thanks to whom the pest has been completely eradicated from many estates.

It is important to again emphasise the necessity of winter spraying before March.

The injury occasioned by these insects is considerable. In this country the spruce and larch are the chief sufferers, for not only do the pines appear to be less attacked, but they seem better able to resist the pest. Further, the diseased trees are less able to withstand the attacks of other insects which then take possession, laying their eggs thereon, or burrowing into the decaying wood, and thus hastening the death of the tree. Fungi also make their appearance, and it has been pointed out by Professor Marshall Ward that diseases such as the Larch Canker no doubt often gain an entrance into the trees through the wounds made by *Chermes* and other insects. The Larch Leaf Rust and Spruce-Shoot Disease are also probably so introduced. Mr. Burdon points out that the hyphae of the fungi are always found in the old galls on the spruce, while the black, bead-like fruit bodies may be seen projecting from the stomata of the leaves, viz., the apices of the needles of the dead gall.

Preventive and Remedial Measures.

The methods recommended by Miss Ormerod, Mr. Blandford, and others—the snipping off of the galls in the summer—is both troublesome and unsatisfactory, for it not only damages the trees, but does not lessen the pest. This is, of course, intelligible when the facts of the life-history are considered, since the supplies on the spruce are kept up by the return of adult winged forms from the larch. Experiments go to show that this drastic treatment is often more serious than that caused by the insects.

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[1] 3rd Report Inj. Insects, 1906, p. 14. See also Burdon: Journ. Econ. Biol., 1907, vol. ii, pp. 64-67.

Miss Ormerod also recommended "drenchings with any of the *Aphis* washes in July, or when the *Chermes* are seen to be hatching," but Mr. Burdon points out that the majority of the galls are closed in July, in consequence of which the fluid would not reach the occupiers, and would therefore be of no effect.

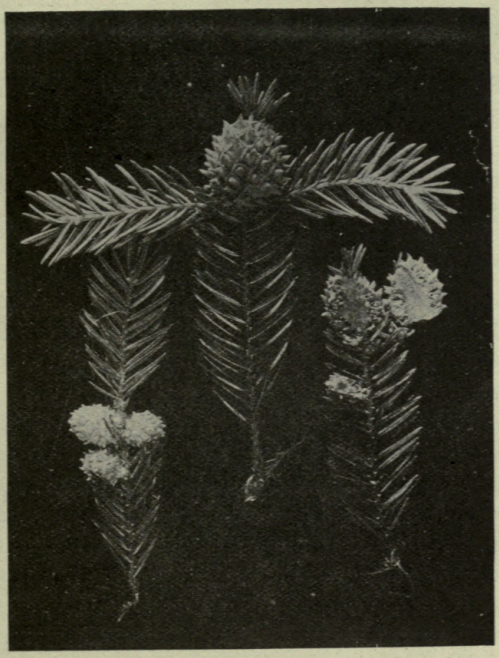

FIG. 14.—Galls formed by *Chermes abietis*. Linn.

Mr. Blandford has suggested washing in April, which would certainly destroy numbers of the mothers and eggs, but would still prove ineffective if the season were early and the larvae had commenced to enter the galls.

It is quite evident from Mr. Burdon's researches that the winter mothers or foundresses must be removed whilst still in the hibernating condition; it is therefore all-important that any washing should be done in the winter. The results from Mr. Burdon's experiments were most satisfactory. He used a sprayfluid consisting of 3 lbs. of soft soap dissolved in two quarts of boiling water, to which 1 pint of paraffin was added whilst still boiling. These were then churned

together, until the whole formed a buttery mass. This stock was then reduced by adding 5 gallons of soft water.

"18th January, 1907. The following branches were then dipped into the wash tub and generally shaken in the fluid until all the parts were thoroughly wetted:—

Branch No.	7	on Spruce	marked B,	on which	23	hibernating *Chermes*	were counted.
"	8	"	"	"	91	"	"
"	9	"	"	"	64	"	"
"	10	"	marked F,	"	83	"	"
"	11	"	"	"	57	"	"
"	12	"	"	"	28	"	"
					346		

Thus 6 branches on two different trees, bearing a total of 346 hibernating *Chermes*, were washed. On March 31st, when the *Chermes* on other branches of the same trees were seen to have awakened, the washed branches were examined, and the *Chermes* on them were apparently dead. Examined again on June 13th, not a single gall was to be found on any of these branches.

Two trees which have been regularly galled year after year, and on which numbers of hibernating *Chermes* were found to be present, were sprayed with the same wash on January 18th. With the exception of about half a dozen galls on branches which the spray failed to reach, both these trees are practically free of *Chermes*.

A further trial of this wash was made on five badly infected Spruces in the Cambridge Botanic Gardens, which Mr. Lynch, the Curator, kindly had sprayed at my request. The buds were just beginning to show signs of swelling, and there were numbers of Chermes seated below the buds, which had just awakened and commenced to suck.

On examining these trees on June 13th, I was unable to find a single gall, though other trees close beside them were laden with galls. No scorching of the foliage has occurred in any case.

Wash No. 2.—Another wash which also gave successful results consisted of a solution of soft soap mixed in the proportion of 1 lb. soft soap to 1 gallon of soft water.

A branch on which I counted some 80 to 90 *Chermes* was dipped

into this solution on March 31st. The buds were just beginning to swell, and the insects were all awake, and had commenced sucking. No galls whatever have developed on this branch, the young shoots have all grown out strong and healthy, and although a few of the last year's needles have turned brown and died, the majority are quite green and healthy, and what damage there is is hardly worth noticing.

Two Spruces, about 20 feet high, were also sprayed with this solution, and although there were plenty of insects awake and sucking at the buds at the time of spraying, I have been unable to find more than two or three galls on the trees, and the presence of these is accounted for by the trees being surrounded below by a clump of Box and Yew bushes, which prevented the spray from reaching all the buds.

It is evident from these experiments that the Pine-Apple galls of the Spruce can be entirely prevented by spraying the trees before the buds begin to open—that is, any time before the end of March—and that there is little risk of any injury to the foliage in such operation."

THE GOAT MOTH.

Cossus ligniperda, Fabr.

Two cases of the larvae of this moth attacking poplar trees and one oak trees have been dealt with during the past season.

The life-history was given in my Second Report for 1904.[1] Since then many inquiries have been received from all parts of the country, the most serious being an attack of this moth on poplar trees at Frinton, Essex, where great damage was committed. As many as seventy larvae, in different stages of growth, were taken from three pieces of a tree each about sixteen inches long.

Although the moth is not observed to any great extent, partly owing to its protective colouring, it is a common species, and has been recorded as damaging a large variety of trees, amongst which are the apple, ash, beech, birch, elm, lime, oak, pear, poplar, sycamore, walnut, and willow.

Life-History.

The eggs of this moth are deposited in little heaps about July in cracks and crevices in the bark, and generally near to the ground,

[1] 2nd Rpt. Inj. Insects, 1905, pp. 29-32, figs. xii-xvi.

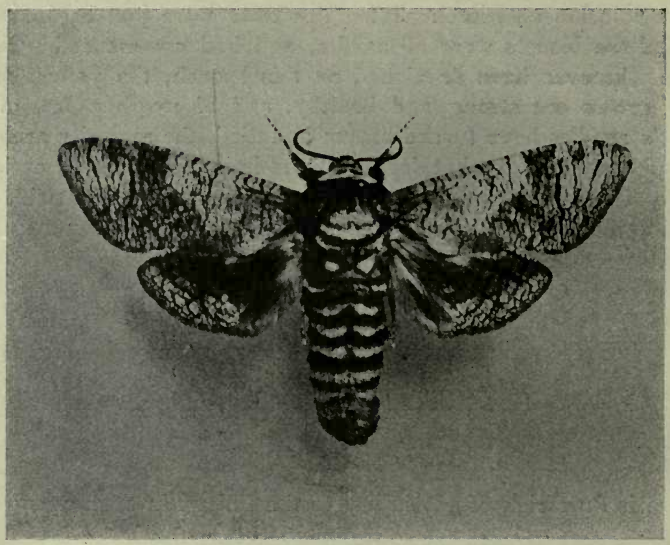

FIG. 15 —THE GOAT MOTH. (*Cossus ligniperda*, Fabr.). Male.

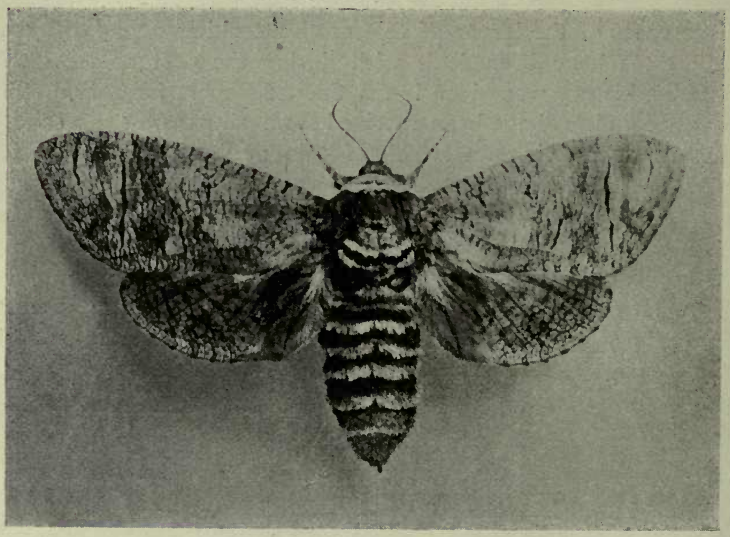

FIG. 16.—THE GOAT MOTH. (*Cossus ligniperda*, Fabr.). Female.

in nearly all the cases I have seen, the eggs have been between one foot and four feet from the surface. They are stated by certain observers to number as many as a thousand, though females kept in

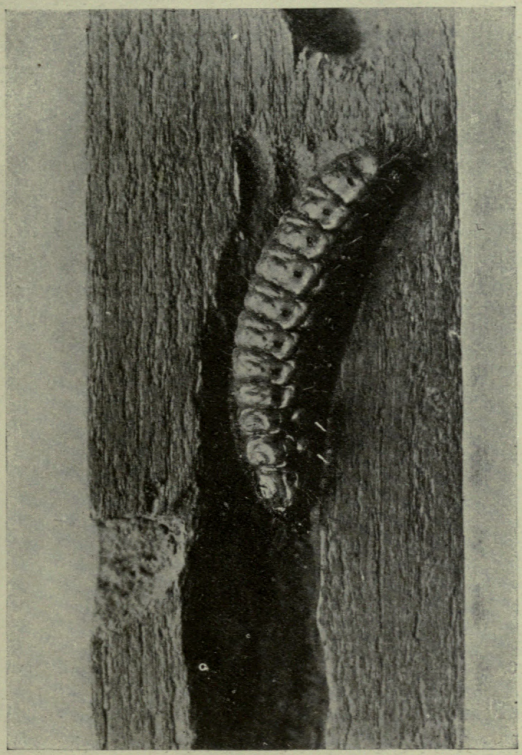

FIG 17.—Portion of Ash Tree with larva *in situ.*

confinement only deposited about three hundred and fifty each. The eggs are of a brownish colour, round, with a flattened base, and ribbed. The caterpillar at first is a fleshy pink colour, later changing to a yellow ochre, with a blackish head and two blackish-brown markings on the first segment; the centre of the back is a deep mahogany red. They remain in the larval condition for three years, measuring three to three and a half inches in length when fully grown. During this period they gradually make their way from the bark into the solid wood, perforating it in all directions with their tunnels. At times they

leave the tree, and in May are often found straying about. Pupation takes place in the spring of the third year. The silken cocoons are covered with bits of wood, and lie just within the entrance of the tunnels. The moth emerges about a month after pupation.

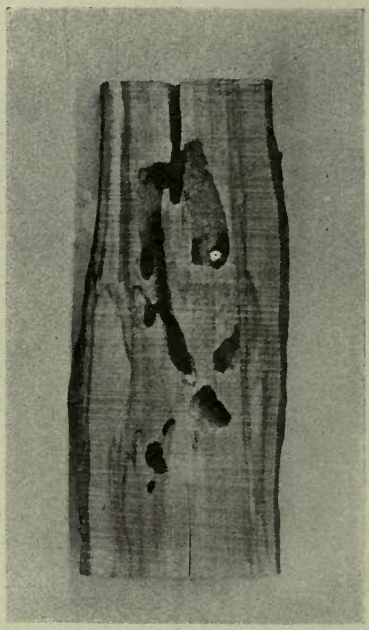

FIG. 18.—Section of Poplar tree damaged by Goat Moth larvae.

PREVENTIVE AND REMEDIAL MEASURES.

On emerging from the pupal condition the moths are often seen resting on the trees, and during May the caterpillars are also often found on the bark; in both cases they should be destroyed. The pupae may be hooked out of the entrances of the tunnels in June or July with a piece of strong wire, bent at one end.

For preventing the moth depositing her eggs in the crevices of the bark, Mr. Theobald[1] recommends smearing the trunks over in May with a mixture of clay and paraffin and soft soap, made into a thick paint, and smeared thickly around the base, and all over the trunk up to eight feet. This mixture is said to answer much better than the clay and cow-dung generally used.

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[1] 2nd Rpt. Econ. Zool., 1904, p. 83.

For killing the caterpillars, paraffin, paraffin emulsion, tobacco-water, etc., squirted into the tunnels, have been recommended; also the fumes of sulphur and tobacco blown into the tunnels. The most certain remedy, however, is to place pieces of stick cyanide into the

FIG. 19.—Portion of Ash Tree, showing entrance to tunnels.

entrances of the tunnels, plugging them up well with clay, and smearing the trunk over with clay also.

Timber badly infested is best destroyed.

THE BUFF-TIP MOTH.

Pygaera bucephala, Steph.

Warwickshire, Staffordshire and Leicestershire correspondents have forwarded the larvae of this destructive moth as damaging elm and beech trees.

When present in large numbers they do much damage to foliage trees and will also attack fruit trees.

Life-History.

The moth makes its appearance about the middle of June, and the female deposits her eggs on the underside of the leaves in groups varying in number from twenty to sixty. Owing to their large size they are somewhat conspicuous. When looked at from above they are seen to be rounded and pearly-white, while towards the base they are greenish, and flat beneath.

In ten or twelve days the larvae hatch out, and undergo the first moult about ten days later. In early life they are gregarious, after a time they separate, but throughout this stage they are always met with in groups. From the middle to the end of September they generally become full-fed, when they commence to descend the trees, either by falling or crawling. They pupate immediately beneath the tree usually in the soil, but may often be found beneath fallen leaves, and remain in this stage until the following June.

The pupa is a deep mahogany-brown, smooth, glossy, about an inch long, and provided with two spines at the apical or pointed end. It is not enclosed in a cocoon.

Preventive and Remedial Measures.

Shaking or jarring the infested boughs has been recommended (Ormerod), but except in their young state they are difficult to dislodge. In September I found it almost impossible to move them. Before jarring, tarred bands of hay should be placed around the trunks so as to prevent the larvae ascending again.

A good plan is to spread a few spadefuls of gas lime around the trees at the end of September, when they commence to descend the trees prior to pupating. Fowls turned on to the land about this time will also destroy both larvae and pupae.

The large size and bright colouring of the larvae render them very conspicuous, and on small trees hand-picking is very effective.

For fruit trees spraying with arsenate of lead should be carried out.

4.—PLANT DISEASES DUE TO FUNGI.

BROWN ROT.

Sclerotinia fructigena, Pers.

Throughout the whole of the seven Midland counties cases of Brown Rot have been reported. It is difficult to say whether this or the disease known as "Black Spot" on Apples is more prevalent, but it is perfectly certain that unless patient and persistent effort is made to eradicate these two diseases, the cultivation of fruit for profit will be almost impossible within a very short time.

In Worcestershire the Brown Rot disease has been very marked during 1910, and considerable quantities of fruit have suffered.

The disease is well known to fruit growers in all its stages.

PREVENTIVE AND REMEDIAL MEASURES.

It is much to be regretted that spraying for this and the following disease is not made compulsory by the Board of Agriculture, whose recommendations are as follows :—

"All dead twigs and shrivelled fruit, whether hanging on the tree or lying on the ground, should be collected and burned during the winter.

After the diseased fruit and dead branches have been removed, the trees and also the ground should be thoroughly drenched with a solution of sulphate of iron, prepared as follows :—

Sulphate of iron	... 25 lbs.
Sulphuric acid	... 1 pint.
Water	... 50 gallons.

Pour the sulphuric acid upon the sulphate of iron, then add the 50 gallons of water by degrees. A barrel is the best vessel to use; a metal vessel must not be used, as it would be acted upon by the sulphuric acid.

Spraying with the above solution should be done in January or February, before the leaf-buds begin to swell in the least, otherwise the foliage and blossom will be destroyed.

When the leaf-buds are expanding, and at intervals as required, the trees should be sprayed with quite weak Bordeaux mixture.

The above line of treatment must be followed for at least two seasons."

APPLE SCAB or "BLACK SPOT."

Venturia inequalis, Aderhold.

This, and the allied disease attacking pears, is at the present time rampant throughout Worcestershire, and in a less degree in the remaining six Midland counties.

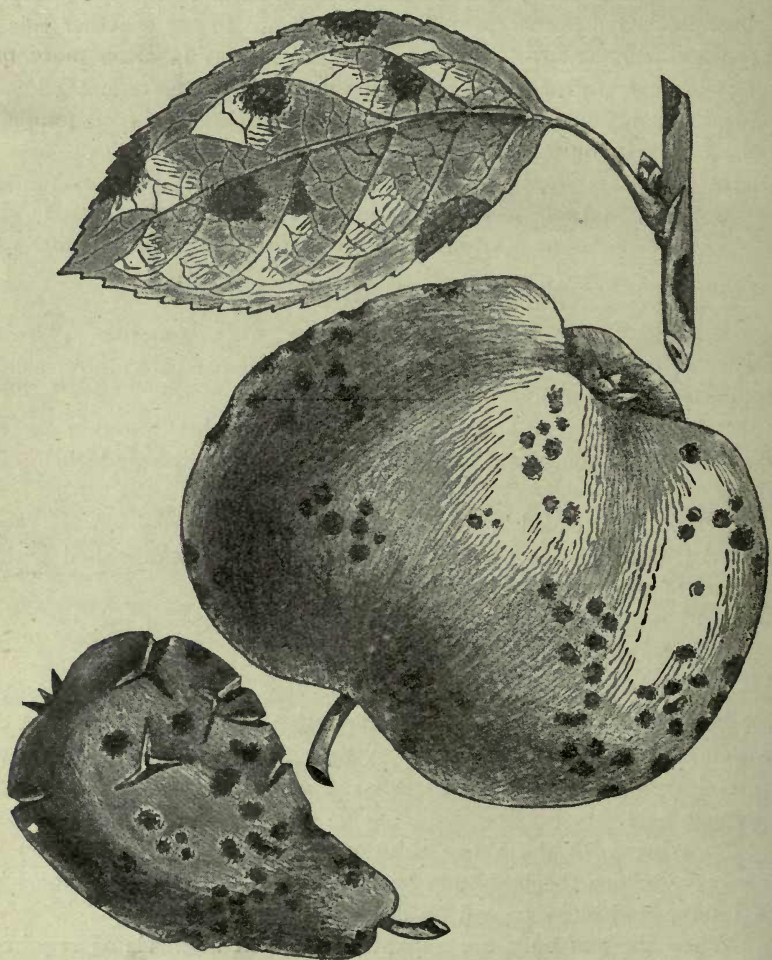

FIG. 20.—APPLE AND PEAR SCAB.

It is by no means so difficult a disease to control as the Brown Rot of fruit trees, but the methods adopted are generally quite inadequate.

I have seen excellent results where close pruning has been carried out in the autumn, and the prunings and all fallen fruit burnt; followed by spraying with 1lb. of sulphate of copper to 25 gallons of water, and as soon as the leaves are out, spraying twice or more with Bordeaux mixture, viz., 6 lbs. of sulphate of copper, 3 lbs. of quicklime, and 100 gallons of water. If this treatment were carefully carried out by fruit growers for a season or two, the cracked, scabby and unsightly fruit so common at present, would be a thing of the past, and instead of the crop forming food for the pigs or being sold at two shillings or less per bushel, it would fetch good prices, much to the grower's benefit.

Both the disease and its remedy are now well known, and it remains entirely with the grower if the former has to be eradicated.

GOOSEBERRY SCLEROTINIA.

Sclerotinia fuckeliana (De Bary).

In Worcestershire this disease has been reported by many growers.

It usually makes its appearance on the base of the stem, the mycelium of the fungus penetrating the bark, cortex, and soft wood. Later, the bark cracks and falls off, leaving the stock naked. In the meantime the little greyish patches of mould give rise to spores, which spread to all parts of the plant, attacking branches, leaves, and fruit.

Frequently a bush attacked in the previous year dies on the re-appearance of the disease in the following year.

Preventive and Remedial Measures.

All dead or seriously diseased bushes should at once be removed and burnt.

If the disease is noticed on the leaves or stems after the fruit has set, the bushes should be sprayed with Bordeaux Mixture, made according to the following formula :—

Sulphate of Copper	4 lbs.
Quicklime	4 lbs.
Water	50 gallons.

It is important that the lime should be freshly burnt lime, and the sulphate of copper of at least 98 per cent. purity. In the following winter, just before the bursting of the buds, spray again with 2 lbs. of sulphate of copper, ½ lb. soft soap, and 50 gallons of water.

SLEEPY DISEASE OF TOMATOES.

Fusarium lycopersici (Sacc.).

This is undoubtedly the worst disease tomato growers have to contend with at the present moment, and unfortunately it is spreading and making its appearance in new areas.

A very large number of inquiries have been received respecting it during the past year, and scores of diseased plants.

Experiments have been made with seedlings from affected soil, by transplanting them to soil dressed with strong solutions of copper sulphate, and in other cases to soil dressed with sulphur. The latter have given better results, but in neither case were the plants saved.

Frequent watering with a weak solution of copper sulphate was also tried, and up to a certain stage gave great promise, but on the plants reaching a height of about eighteen inches, they suddenly collapsed, and quickly died.

The disease is due to a soil fungus, which enters the plants by the roots. The first signs of attack are noticeable by the leaves drooping and changing colour; later the stem collapses, and ultimately becomes covered with a delicate white mould, which produces spindle-shaped spores in large numbers. If allowed to remain in the ground, irregular yellowish patches appear on the decaying stem. If a transverse section be made of the lower portion of the stem a brownish ring is noticeable just below the epidermis.

So far as is known plants that are once attacked always die. Spraying is useless.

Soil in which the disease has appeared should be treated with ground unslaked lime, which should be thoroughly incorporated with the soil. After a week it should be watered, and then allowed to lie for a time before planting anything in it.

When grown under glass, every part of the house should be well washed with a carbolic acid solution, consisting of one part of acid to twenty parts of water.

All affected plants should be removed and burnt upon the first appearance of the disease.

THE WILT DISEASE OF TOMATOES AND CUCUMBERS.

Mycosphaerella citrullina, Grossenb.

Not for many years past have tomato and cucumber plants suffered from disease to such an extent as in the season 1910, and, unfortunately, to the many fungi attacking these plants we have to record the further spread of the Wilt or Canker disease, due to a fungus known as *Mycosphaerella citrullina*.

The disease was first described by Dr. Grossenbacher[1] in 1909, as attacking muskmelons under glass in the State of New York. He mentions that the vines had practically reached their full growth before the trouble appeared, indeed some of the first fruits were nearly ripe. The disease was preceded by a rather severe attack of the mite *Tetranychus telarius*, commonly termed red "spider."

Leaflet No. 230 of the Board of Agriculture and Fisheries, dated February, 1910, records that specimens of diseased tomato plants were received from Waltham Cross at Kew in 1909, suffering from this disease, and from Gloucestershire a cucumber plant.

FIG. 21.—TOMATO AND CUCUMBER WILT.

[1] N.Y. Agric. Exp. Stat., Tech. Bull. No. 9, 1909.

During the present year I have seen a large number of houses of cucumbers attacked at Waltham Cross, and have examined very badly infected specimens of tomato plants from Hertfordshire. This disease having appeared in these three widely separated counties, there is every probability that it is present elsewhere, and that many of the numerous cases of wilting which have occurred during the past season, and which have been ascribed by ignorant persons to eelworms, are due to this disease.

Dr. Grossenbacher's experiments show that inoculations made in the open were almost failures, the moist, warm conditions obtaining under glass being the essential and all important factor for the infection and development of the fungus.

In addition to the muskmelon, the cucumber, West Indian gherkin, Boston Marrow Squash, pumpkin, and two species of gourds were infected, but the fungus had no effect on any but one of the gourds, although it was able to vegetate and fruit on the dead vines of other species.

Preventive and Remedial Measures.

Wherever the disease appears the haulm should be sprayed with Bordeaux mixture; this should be repeated at intervals until the fruit is gathered, and then the whole of the haulm burnt.

Before removing the soil from infected houses it should be treated with a liberal application of ground unslaked lime. The same soil should not be used again for two or three years.

Grossenbacher (*loc. cit.*) has shown that the spores are not killed by exposure to the weathering conditions of winter. The disease, he states, may readily be prevented in the greenhouse by spraying thoroughly with Bordeaux mixture, when the plants are about half-grown (*i.e.*, before the disease appears), and repeating the applications often enough to keep them covered with the sprayfluid.

Good ventilation, so seldom present, is all important.

POTATO SCAB.

Oospora scabies, Thaxter.

This disease, of which there has been a large amount in the Midland Counties during the past year, causes very little damage to the potato itself. It attacks the young tubers, and forms rough, scab-

like patches on the surface, not unfrequently covering the whole of the tuber, and thereby considerably depreciating their market value.

Thaxter has shown, that as the result of extensive experiments made by him, that a complete specific is afforded by soaking the seed potatoes in a solution of one pint of formaldehyde in *fifteen gallons* of water, for a couple of hours. The Board of Agriculture recommend one pint of formaldehyde in thirty-six gallons of water.[1]

In addition to the potato, swedes, beet, carrots and cabbages are attacked by this fungus, so that cereals should be sown on land where the potato crop in the previous year has shown the disease.

Although growers are generally agreed that this disease is favoured by the presence of lime in the soil, more carefully planned experiments and further evidence on this point are very desirable.

Stable manure and night-soil should be avoided, and acid manures only put on to infected land.

YELLOW WART DISEASE.

Synchytrium solani (Massee).

From various localities diseased tubers have been received. Some futher experiments have been made on treating the soil with lime and sulphur, and others are in progress.

As Mr. George Massee[2] remarks in his recent and excellent handbook, " The only methods that can be suggested for checking the spread of the disease are of a preventive nature, and as these are unfortunately mostly outside the range of what may be expected of the potato-grower, or, for the matter of that, any one else, the field is open for the stump-orator, whose energies are expended in denouncing the powers that be for not promptly suppressing all traces of the disease from the British Empire. Difficulty No. 1 consists in the fact that a potato used for ' seed ' may be so slightly infected that the disease would not attract the attention even of an expert. If such a potato is used for ' seed ' a diseased crop will probably result, at all events the land in which the crop grew will be infected. Difficulty No. 2 turns on the fact that when land is once infected it remains in a condition capable of imparting the disease to potatoes after

[1] Leaflet No. 137, March, 1905. Revised, March, 1906.

[2] Diseases of Cultivated Plants, 1910, p. 102.

a period of five years, as proved by careful experiments conducted at Kew. This infection is brought about by the liberation of the resting-spores of the fungus into the soil. When a potato becomes diseased the presence of the fungus in the tissues enables other fungi and bacteria to gain admission, and the tuber often rots and decays under the combined influence of these various organisms before the time for lifting the crop arrives. No amount of legislation can prevent the rotting of such potatoes, and the consequent liberation of resting-spores in the soil. It is an insult to any potato-grower to caution him against using for 'seed' potatoes obviously attacked by black scab; on the other hand, if he uses 'seed' so slightly attacked that he cannot see the disease, he is not responsible for the result. The only suggestion that can be offered is that of procuring 'seed' from a district where the disease has not been notified. So far as is known, the disease is confined to the potato, consequently when land is known to be infected, by having produced a diseased crop, do not attempt to grow a crop of potatoes again for at least six years, unless very stringent measures are taken to destroy the organisms present in the soil. The land must be fallowed and dressed with gas-lime, at the rate of from four to five tons per acre. Slightly diseased potatoes should not be given to animals raw, but should be always boiled first."

FINGER-AND-TOE DISEASE.*

Plasmodiophora brassicae, Wor.

This fungus was first described by Woronin in 1878, and his observations have repeatedly been confirmed. The fungus in question belongs to a family known as Myxomycetes or Slime Fungi, which are characterized by the absence of cells or cell walls during their vegetative period, but later, the protoplasm becomes divided up into small portions, each of which is ultimately surrounded by a definite cell wall. These are termed spores, and may retain their vitality for several years. Under suitable conditions, germination takes place, and part of the contents become exuded. At first the cell wall is noticed to crack and a small portion of the protoplasm passes out. Little by little it becomes attenuated into a long hair-like body, the

* Largely abstracted from a lecture delivered before the Warwickshire Chamber of Agriculture, May 2nd, 1908.

whole mass ultimately leaving the spore. A series of these free and independent pieces of protoplasm coalesce and form what is known as a plasmodium, similarly formed plasmodia next become conjoined,

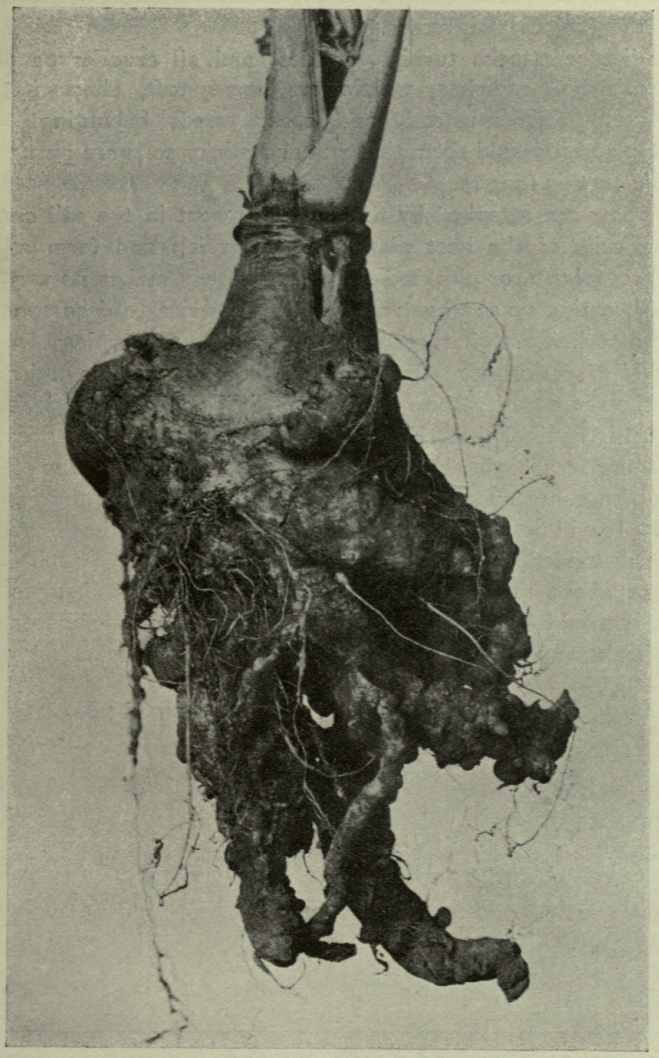

FIG. 22.—SWEDE ATTACKED BY FINGER-AND-TOE DISEASE.

forming homogeneous masses of protoplasm, which possess the power of creeping about by pushing out arm-like processes. The outer portion of the plasmodia is of a thinner and more slime-like nature than the inner portion, and this former is often left behind in the form of a slime as the fungus progresses.

The disease attacks turnips, swedes, and all cruciferous plants, such as cabbage, radishes, wallflowers, candy-tuft, charlock, shepherd's-purse, garlic mustard, and other weeds belonging to the Cruciferae, and it would seem that wet and sticky soils are particularly favourable to this fungus.

The roots are attacked by the spores present in the soil entering the living cells of the host plant; these develop and form a slimy mass of protoplasm, or plasmodium, which slowly makes its way from cell to cell, eating up the contents, and giving rise to decomposition. Roots so attacked are characterized by swellings of varying sizes and shapes. If a section is made of one of these, it will be noticed, on viewing the same under the microscope with a low power lens, that there is an irregular, though somewhat ring-like, mottled area, and examined under a high power lens, this is seen to be due to the presence of a slimy mass of a stringy nature, wholly or partly filling the cells. It will be further noticed that all the diseased cells are considerably distended, although yet remaining intact. Such is the appearance about the month of July. If the further changes were watched, it would be noticed later that the slimy mass of protoplasm becomes broken up into millions of exceeding minute, spherical spores, each of which possesses a cell wall.

The cells of the turnip are still intact, although considerably more distended, and here the spores remain throughout the winter, germinating, as already described, in the spring. As the roots decompose the spores are liberated into the soil, and ready to infect a new crop.

Numerous experiments have been made as to the effect of lime upon this disease, the most interesting and successful, perhaps, being those carried out under the direction of Professor Gilchrist, at Cockle Park Farm, Northumberland.[1]

Whilst no cure has been found at Cockle Park, it has been clearly

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[1] "Report on Back House Rotation Experiments, and Finger and Toe Disease," by Prof. Douglas A. Gilchrist.

shown that light dressings of lime, applied once during each four-course rotation, make it possible to produce fair crops of swedes and turnips where hitherto this was not so :—

Summarizing and noting the suggestions made, we note that :—

1.—It was found, as a result of a series of well-planned and carefully carried out experiments at Cockle Park Farm, that all dung produced by animals, receiving as food diseased swedes or turnips, should only be used on permanent hay or pasture land, and not upon arable land, otherwise diseased portions of the roots in the dung would propagate disease.

2.—Live stock should not be fed with diseased swedes or turnips on temporary leys, but only on permanent pasture land. All tailings, or refuse from diseased roots, should also be removed to permanent pasture.

3.—The troublesome annual weed, charlock, which will do much to increase the virulence of the disease, must be rigidly exterminated, either by spraying with sulphate of copper in the case of infested corn crops, or by hoeing and cultivation to clear it from the root crops.

4.—It was further found that on land farmed on the four-course rotation plan, that the substitution of potatoes, mangels, or beans, or any other crop not allied to swedes or turnips, etc., during one rotation, will greatly modify the attack of this disease.

5.—The extension of the four-course rotation, by leaving the land down for two to three years to temporary hay or pasture, will also greatly assist in checking the disease, unless diseased roots are consumed thereon.

6.—The cultivation of heavy land, while it is in a wet, sticky condition, evidently favours the disease.

7.—Common lime, at the rate of 2½ tons per acre, slaked to a fine powder, and thoroughly mixed with the soil, is usually productive of the best results.[1] Its application should be as soon as possible after the removal of a diseased root crop, but the soil must be fairly dry when this is done, and the surface soil must be well mixed with it. No good results can accrue if applied to a wet soil, or if it is too deeply buried, or if in a pasty condition, and thereby remain in even small lumps in the soil and not distributed thoroughly. Lime may

[1] Ground unslaked lime, at the rate of 10 cwt. per acre, has given excellent results in experiments made during the past three years.

also be applied with about equal advantage to the hay stubble, and with good effects to the oat stubble, or even a few months before turnips are sown, provided it can be thoroughly distributed throughout the surface soil.

Heavier dressings of lime, say up to 10 tons, are likely to prove more effective, but not in proportion to the cost. Lighter dressings, either of common lime, or ground lime, are not so useful as is a dressing of 2½ tons of common lime. Experiments also go to show that lime may be even more effectual on the second than on the first crop which follows its application. *Lime probably does not check the disease to the greatest extent till many years afterwards.*

Judiciously applied, heavier dressings of gas lime, where this is easy to procure, may be useful, and this is probably best applied to hay stubble, but on this it should be carefully spread and exposed for at least two months before being ploughed in.

It is of the utmost importance that the lime, when applied to the soil, should be thoroughly distributed, and to secure this it is best to slake the lime (with sand) into a fine powder, in which condition it can be easily spread, as on account of the sand it cannot be blown about by the wind, and can be spread with less trouble and more effectively.

8.—Poor, heavy, clay loam, with a low percentage of lime, should not be used for swedes or turnips if it can be avoided. Turnips are best suited for the lighter soils, even though they are poorer chemically; and if the subject of Finger-and-Toe, the judicious use of light dressings of lime has proved more effective on these than on clay soils.

9.—The practice of allowing sheep to eat off swedes, or turnips, on the land may considerably encourage the disease. Firstly, by the fact that diseased portions of the roots may be left behind by the sheep; and, secondly, the consolidation of the soil by the treading of the sheep also encourages the disease.

There is now no longer any doubt as to the influence of lime upon the Finger-and-Toe disease, indeed, up to the present time, liming is the only method that has given any reasonable success.

In 1909, I pointed out that a combination of lime, followed by a dressing of sulphur, might possibly give much better results than have yet been obtained, and experiments carried out on a small scale fully support this view.

BEAN ANTHRACNOSE.

Colletotrichum lindemuthianum (Sacc. and Mag.).

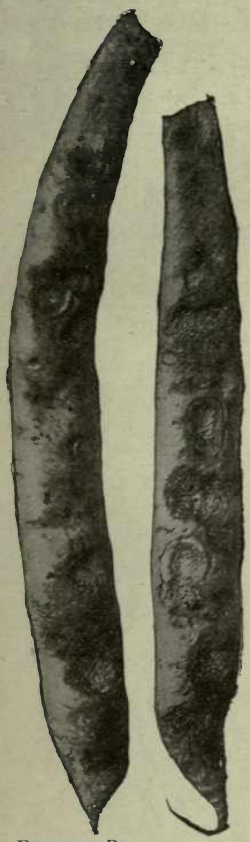

FIG. 23.—BEAN ANTHRACNOSE. Pods shewing canker.

During the past year very serious losses have been occasioned to scarlet runners and French beans by the disease known as Anthracnose, Bean Pod Canker, and Pod Spot, and as no adequate account has been given of the disease in this country, it is here treated of at some length.

Whetzel[1] has shown that the disease is due to a fungus which lives as a parasite in the plant tissues. The first appearance of the fungus is on the seedlings, and appears as brownish-coloured spots or pit-like spots on both seed-leaves and stem. In some cases the stem is so badly attacked at its base with pitted spots, that the young plants fall over and die. Later, on each of these spots, spores are produced, and these are carried on to the leaves and stems of the plants. In bad attacks the leaves are eaten through, and irregular cracks or holes, with blackened margins, appear.

At a still later date after the fungus has established itself upon the stems and leaves, it spreads to the pods. Each spore that falls upon the pod, in the presence of moisture and a suitable temperature, develops a minute germ-tube, which enters into the tissue of the pod (Fig. 26), and commences to branch and feed upon the tissues of the plant. The characteristic rusty brown spots now appear as pit-like spots, and here more spores are formed (Fig. 25). These are piled up in minute pinkish masses and held together by a sticky secretion. A drop of rain or dew is sufficient to dissolve this mucilage and set free the spores.

As the pods develop the mycelium of the fungus penetrates deeper

[1] Cornell Univ. Agric. Exp. Stat., Bull. 239, 1906.

and ultimately reaches the seed. It now makes its way through the seed coat and establishes itself there. It may entirely destroy the seed, or what is usually the case, the seed ripens and encloses the fungus, which remains dormant. Seeds so attacked have brownish or yellowish coloured patches. If badly attacked they become partly shrivelled.

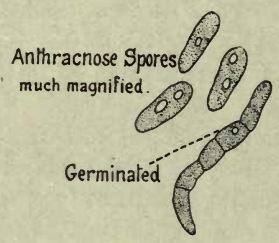

FIG. 24.—Magnified view of the spores, one of which has germinated. (After Whetzel).

FIG. 25.—Diagrammatic section across a bean pod through an anthracnose canker. (After Whetzel).

When such seeds are planted in the spring the fungus develops, forms spores and infects the young seedlings as already described.

PREVENTIVE AND REMEDIAL MEASURES.

Numerous experiments have been made with soaking the seeds in formalin, etc., but as the fungus is internal the results of seed treatment have not proved satisfactory.

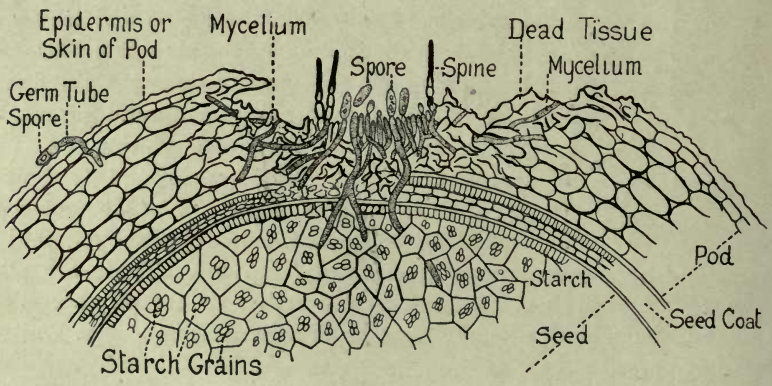

FIG. 26.—Enlarged view of portion of Fig. 25, showing the mycelial threads of the fungus penetrating the seed coat and entering the starchy tissue of the seed, there to remain dormant until the following season. (After Whetzel).

Wherever the disease is noticed on seedlings they should at once be pulled up, placed in an old sack and the lot burnt away from where they were growing.

The best method of treatment is to spray the young plants with Bordeaux mixture, using 5 lbs. of sulphate of copper and 4 lbs. of lime to 50 gallons of water. The first application should be given as soon as the plants are well up, and the first pair of true leaves commence to unfold.

A second application should follow ten to fourteen days later, and, unless a large quantity of rain has followed, a third application shortly after the blossom appears.

It is all important that the spraying should be thoroughly done and every part of the plant above the ground wetted.

DISEASES OF BULBS.

Quite a large number of different species of bulbs have been examined from the Midland and Eastern Counties attacked by fungi, some of which are worthy of record. This is the more important seeing that during the past few years bulb cultivation has greatly increased in the United Kingdom. Those growing for pleasure and those for profit are more numerous than ever before, whilst the area under cultivation is annually increasing.

Much experimental work has been carried out, and I believe the remedies advocated, although often of a simple nature, will do much towards making bulb cultivation more practicable and profitable.

There is still a wide field for investigation and experiment, and I shall gratefully welcome any suggestions, specimens, etc., from those interested.

It is only fair to state that many of the largest bulb growers in this country have rendered me considerable assistance. Most, if not all, with whom I have come into contact, take every possible precaution to secure the very best material, and even of that imported from abroad only the best is accepted. I feel it is only fair to the Trade to state this. There are, however, a few people who offer cheap bulbs, which are certainly not desirable, and private growers have only themselves to blame if they purchase such.

IRIS LEAF-BLOTCH.

Heterosporium gracile (Sacc.).

This is often a very troublesome disease on *Iris germanica* and other species. In 1909 and 1910 it was particularly prevalent.

The appearance of the mould is very variable according to the particular species of host-plant and the season. Generally the upper surface of the leaves turns brown and commences to decay; roundish or oval black blotches next appear from half to one inch in length, or these may occur on leaves which appear to be perfectly healthy. Sometimes the blotches are smaller and more numerous. In either case, later, there develops on these areas a sooty-brown mould, consisting of short, thick, jointed threads, which bear conidia. These latter vary in size, are usually transversely divided once or twice, the surface of each cell being covered with minute points. The conidia germinate freely, and if left undisturbed the disease spreads rapidly.

Spraying with sulphate of copper has been recommended, but I have obtained excellent results with potassium sulphide, an ounce and a half to every three gallons of water and one ounce of soft soap. It is all important that the spraying should be commenced immediately the brown blotches on the leaves appear, and repeated three or four times at intervals of three or four days.

HYACINTH YELLOW DISEASE.

Pseudomonas hyacinthi (Wakk.).

There is no more troublesome or serious disease attacking hyacinths than the one here mentioned. A lengthy investigation has been made and is still being continued. So far the facts point to the disease being due to the *Pseudomonas,* which appears in the autumn in masses of slime in the vascular bundles. In the spring they make their appearance in the vascular bundles of the leaves, and the plants quickly die. Very often the bulb rots away before.

Associated with, and swiftly following, the attack of the bacteria is a fungus called *Hypomyces hyacinthi.*

Diseased bulbs usually contain a number of kinds of bacteria, as well as the familiar mould *Penicillium glaucum,* all of which tend to make investigation difficult and somewhat complicated.

Infection trials of sound bulbs during the winter failed to cause infection.

It appears likely that if the disease has to be eradicated, growers will have to adopt some method of soaking the bulbs before they are dried and put away, and again before they are sent out. For this purpose formaldehyde is worth experimenting with, the bulbs to be soaked in one pint of formaldehyde mixed with thirty gallons of water, and allowed to remain in the fluid for an hour and a half. Experiment only will prove the right strength of the fluid, and the proper length of time to leave the bulbs in.

ORNITHOGALUM BLACK MOULD.

Heterosporium ornithogali (Klotsch).

A severe attack of the Black Mould on *Ornithogalum umbellatum* is worthy of record.

The disease appears as minute, irregular, brownish sooty-like spots, irregularly distributed on areas of varying extent on the leaves. They quickly spread and the leaves rapidly decay.

When examined microscopically the sooty-like patches are seen to consist of a mycelium and dark thread-like bodies. These latter appear in tufts, consisting of short, thick cells, with their walls, sometimes branched, and bearing at their apices the conidia. The conidia are of variable size, some being elliptical with a single transverse division, whilst others are elongated and divided into three, four, or more cells; they have a rough surface with minute points.

If attended to in time, spraying with potassium sulphide will arrest the spread of the disease. All diseased leaves should be burnt.

5.—ANIMAL PARASITES AND DISEASES.

INTESTINAL PARASITES OF PIGEONS.

In examining a number of pigeons from a loft in which there had been a heavy mortality, the following two parasites were met with—*Heterakis maculosa,* Rud., and *Trichosomum tenuissimum,* Dies. The latter was rare, but the former was present in large numbers, and undoubtedly was the cause of death.

The chief symptoms are loss of appetite, re-occurring diarrhoea and wasting. The intestines generally show distended patches of the mucuous membrane, ulceration, and masses of blood. The faeces contain large numbers of eggs.

As this parasite is largely spread from bird to bird by the soiling of the food by the faeces of diseased birds, it is important that such should be separated from healthy birds, and all food fed in a proper receptacle.

As to treatment, Neumann recommends in mild cases each bird receiving 6 centigrammes of calomel worked up with soft bread or made into pills with buttter. In more serious cases powdered areca-nut in 1 gramme doses, worked up in the same manner, should be given.

Scrupulous cleanliness is all-important, and the frequent washing and disinfecting of floors, ceilings, walls, perches, nests, etc.

THE HORSE LOUSE.

Haematopinus macrocephalus (Burm.).

This, the sucking louse of the horse, is generally supposed to be met with only on dirty and neglected animals. In a case reported upon during the past few months, however, these were certainly not the conditions present, the animals being beautifully groomed and with clean surroundings. The only possible explanation for the presence of the lice was that they had been covered with a horse cloth from another stable whilst standing waiting. Whether the lice can

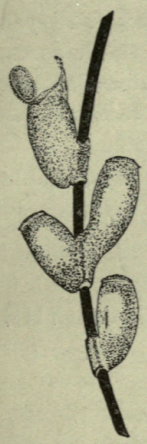

FIG. 27.—THE HORSE LOUSE.
Eggs (much enlarged).

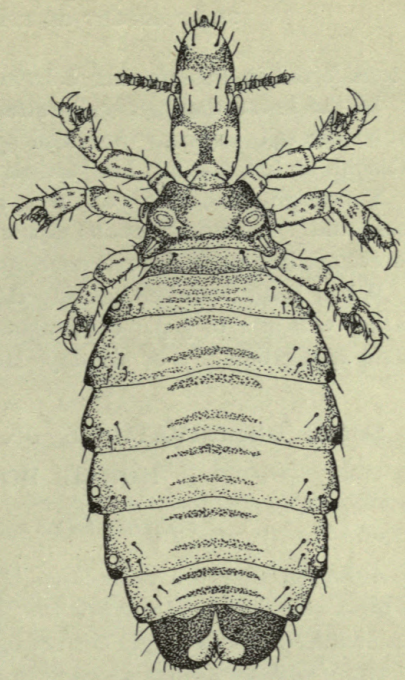

FIG. 29.—THE HORSE LOUSE. FEMALE.
(Much enlarged).

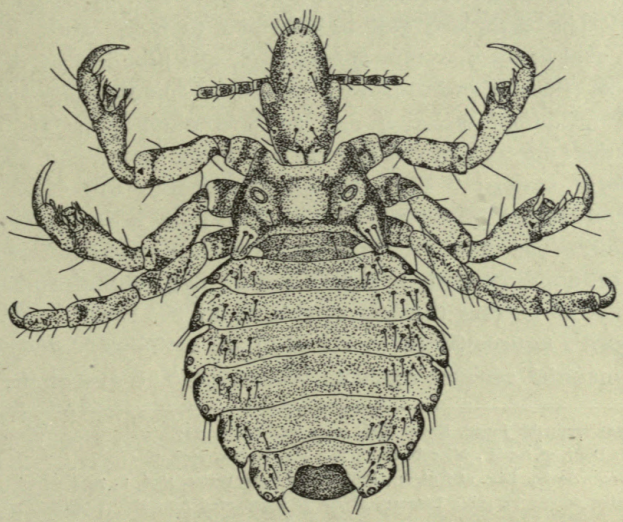

FIG. 28.—THE HORSE LOUSE. MALE. (Much enlarged).

be transferred in this manner I have not sufficient evidence to show.

In the horse they generally attack the mane and neck, and the root of the tail, whereas the allied species of the ox (*H. eurysternus* (Nitzsch), and *H. vituli* (Linn.) attack the head, back and loins as well.

Thorough cleansing of the skin of all animals attacked is essential. Where poisonous dips are used care should be taken not to dress too large a surface at once, and not to use the fluid too strong.

When badly attacked, closely clipping the hair is advisable, and treating with a 1 to 5 per cent. aqueous solution of creolin, giving a second application five or six days later.

SOME OBSERVATIONS ON THE EGGS OF THE HORSE BOT FLY.*

Gastrophilus equi (Fabr).

Although there is a voluminous literature treating of the structure and life-history of the Horse Bot Fly, *Gastrophilus equi* (Fabr.), I have been unable to find a single correct figure of the egg of this insect.

Many authors do not figure it at all, whilst those that do, represent it in an incorrect manner.

The most recent description I know of is that by Froggatt,[1] who states: "The eggs are dull light-brown to dirty white in colour, elongate oval in form, somewhat pointed, and broadest at the apex." His figures (Figs. 3 and 4) show a somewhat spindle-shaped egg, with strong *longitudinal* striation and an operculum lying at the right angle to the long axis of the egg, and with the broad end uppermost.

Osborn[2] states: "They are about one-sixteenth of an inch in length, and taper a little towards each end, though the attached end is the smaller. The outer end is provided with a little cap (operculum), which is set quite obliquely to the axis of the egg, though some authors represent it as cutting the egg square off at the end."

Osborn's figures (Figs. 37 *a* and *b*) are both upside down.

Neumann's[3] account reads as follows: "The ova of the *Gastro-*

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* Reprinted from the Journ. Econ. Biol., 1910, vol. v, pp. 9 17.

1 N.S.W. Dept. of Agric., Miscell. Pub., No. 432, March, 1908, p. 3.

2 U.S. Dept. Agric., Div. of Entom., Bull. No. 5, new series, 1896, p. 79.

3 A Treatise on the Parasitic Diseases of the Domesticated Animals. English Trans., 2nd ed., 1905, p. 293.

philus of the Horse are yellowish-white in colour and conical in shape, being 1.25 mm. long; they are transversely striated, and provided at the larger extremity with an operculum, which is obliquely truncated. They adhere to the hairs by their narrow end, in the same manner as the 'nits' of the Louse, by means of a viscid matter that is deposited with them; their wide end remains pendent."

The idea that the eggs were conical at one end and adhered to the hairs of the horse by a sticky secretion seems to have been copied from Bracy Clark's account[1] by practically all succeeding writers.

No mention is made of the egg by Schroeder van der Kolk[2] in his classical account of the anatomy of this insect.

A careful examination of the egg at once proves the incorrectness of the above accounts, and it seems strange that when the eggs of other species of *Oestridae* have been so carefully figured and described, no one should have thought it worth while to carefully examine those of the species under consideration.

I therefore propose to here give a short description of the egg, together with figures made from recently deposited specimens.

When deposited the eggs are almost white in colour, afterwards turning to a light yellow or a dirty white. They show a well-marked series of transversely raised ridges situated at about equal distance apart, here and there having a wavy or sinuous character and occasionally merging into one another.

In length they average 1.25 mm. and taper to a blunt point at one end and are obliquely truncate at the other. This the anterior or pendent end is covered by a cap or operculum, which lies obliquely to the long axis of the egg and not at a right angle.

Like that of *Hypoderma* the egg may be said to consist of two parts, viz., the egg proper and a pair of lips or valves, which close round the hair and secure the attachment of the egg. The wavy striation is continuous over these lip-like bodies.

If the egg is detached from the hair the margins of these lips usually adhere to it and a very definite attachment surface can be made out on the egg. (Figs. 30, 31).

The peripheral margin of the operculum extends slightly over the

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[1] Trans. Linn. Sec., 1797, vol. iii.

[2] Nieuwe Verhandl. K. Nederl. Inst., Amsterdam, 1845, T. 9, pp. 1-55, plts. i-xiii.

edge of the opening of the egg, and so when the slightest friction is brought to bear upon the ripe egg it is easily torn off.

When newly deposited, what I have termed the attachment surface and the inside of the two lateral extentions are covered with a

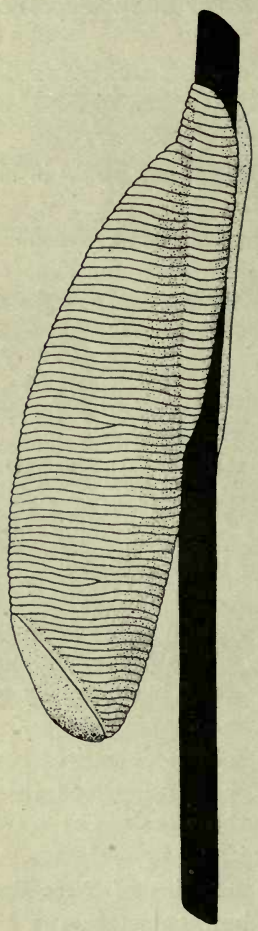

Fig. 30.

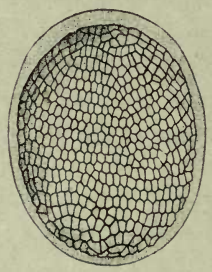

Fig. 32.

Fig. 31.

THE HORSE BOT FLY.

FIG. 30.—Egg of *Gastrophilus equi* (Fabr.), attached to hair by lip-like valves.
FIG. 31.—The same seen from under side, showing attachment surface.
FIG. 32.—Operculum, seen from above.

sticky matter which soon dries, at the same time the lateral extentions close around the hair and almost meet together, thus very firmly securing the egg to the hair.

In spite of many statements to the contrary it is most unusual for the eggs to be detached by the action of the horse's tongue. What actually takes place is the operculum is brushed off and the larva within is carried by the tongue to the horse's mouth.

The empty eggs may be found weeks after, firmly attached to the hairs on the shoulders, forelegs, mane, etc.

The operculum is convex above and marked with a honeycomb pattern (Fig. 32). I hope to give some further particulars in a later paper respecting this.

Experiments with the Eggs.

The various statements respecting the hatching of the eggs are very contradictory and in not a few cases inaccurate.

Very briefly I wish to set forth the accounts given by different observers.

Verrill[1] states that "the eggs contain more or less perfectly developed larvae when laid; and when they are mature or have been a few days attached to the hair, they burst open and allow the young to escape almost instantaneously, when moistened. Thus when the horse licks itself, or its companions, the moisture hatches the eggs, and the young larvae are transferred to the mouth by the tongue or lips.

Froggatt[2] states "These eggs are generally deposited on the jaw, shoulders, or flanks of the animal, from whence, through the animal licking itself, they are conveyed to the lips and mouth, the warmth dissolving the gluey secretion and hatching the enclosed maggot, thus enabling it to crawl out into the throat."

Neither of these statements are borne out by the observations here recorded.

Bracy Clark's account,[3] although given upwards of a hundred years earlier, is much more correct. He writes:—"The eggs thus deposited I at first supposed were loosened from the hairs by the moisture of the tongue, aided by its roughness, and were conveyed to

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1 The External and Internal Parasites of Man and Domestic Animals. Hartford, Conn., 1870.
2 *Op. cit.*, p. 3.
3 *Op. cit.*

the stomach, where they were hatched; but on more minute search I do not find this to be the case, or at least only by accident; for when they have remained on the hairs for four or five days they become ripe, after which the slightest application of warmth and moisture is sufficient to bring forth in an instant the latent larva. At this time, if the tongue of the horse touches the egg, its operculum is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches; in which case its existence to the full growth is more precarious and certainly not so agreeable, as it is exposed to the bitterness of the bile.

I have often, with a pair of scissors, clipped off some hairs with the eggs on them from the horse, and on placing them in the hand, moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the larva would not appear, though held in the hand, under the same circumstances, for several hours; a sufficient proof that the eggs themselves are not conveyed to the stomach. . . . The eggs, in the first place, when ripe, often hatch themselves, and the larva, without a nidus, crawls about till it dies; others are washed off by water, or are hatched by the sun and moisture, thus applied together."

Other writers state that the eggs hatch after a time, and the horse, feeling the irritation of the larvae creeping over the skin, licks itself and thus conveys them to the mouth.

Finally, Osborn[1] has recorded a series of most interesting experiments. He writes: "Eggs collected from a horse while flies were depositing, and therefore probably not long laid, were opened at different times by rubbing them with a moistened finger, simulating as nearly as possible to the action of the tongue in licking the body. While the larvae appeared to be fully formed during the first three or four days after deposition, the eggs hatched with difficulty and the larvae seemed inactive, and all larvae that were freed in this manner up to the tenth day were hatched with difficulty, though the larvae at the end of this time was becoming fairly active.

Four weeks after hatching the eggs opened with the slightest touch of a wet finger, and the larvae adhering to the finger were very

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[1] *Op. cit.*

active, though in some cases they were inactive and apparently dead. About five weeks after collecting the eggs nearly all gave only inactive or dead larvae, though opened with ease on being touched by the finger, and in forty days after collecting no living larvae could be found in the remaining eggs, except one which had succeeded in pushing off the cap of the egg and partially emerging.

In view of these results, I concluded :—

(1) That the eggs of the horse bot fly do not hatch, except by the assistance of the horse's tongue.

(2) That hatching does not ordinarily occur within ten or twelve days and possibly longer, or if during this period, only on a very continuous and active licking by the horse.

(3) That the hatching of the larvae takes place most readily during the third to fifth week after deposition.

(4) That the majority of the larvae lose their vitality after thirty-five to forty days.

(5) That the larvae may retain their vitality and show great activity upon hatching as late as thirty-nine days after the eggs were deposited.

(6) That it is possible, though not normal, for eggs to hatch without moisture or friction.

(7) That in view of these results, the scraping off of the eggs, or their removal or destruction by means of washes will be effective, even if not used oftener than once in two weeks during the period of egg deposition, and, probably, that a single removal of the eggs after the period of egg deposition has passed, will prevent the great majority of bots from gaining access to the stomach, or at least so large a proportion that little injury is likely to occur.

Wishing to know still more definitely the period of most ready hatching, and the effect of different washes for treatment, I suggested to a veterinary student, Mr. Harry Shanks, a careful series of observations, which were carried through during the summer of 1894.

From this study, which was made under my direction, and so that I had frequent opportunity to note progress, a number of points were gained, which are worth adding to the above record. Three hundred eggs were collected from a horse which had been previously freed from eggs, so that the exact date of deposition was assured. The eggs were tested every day.

On the day of collection (first day) the eggs appeared immature. One day later eight eggs opened by picking the operculum off, showed three larvae with slight movement, and five immovable. On the third day a half-hour of friction failed to hatch eggs, but the larvae when freed by picking off the operculum showed two, slight movement; one, no movement, and one sufficient movement to get out of the opened shell.

On the fourth day the larvae in eleven eggs were all active, but had to be freed by picking off the operculum; the same was true up to the seventh day, the only difference being noted in greater maturity and size of larvae.

On the ninth day, or when the larvae were eight days from deposition, one larva was freed by seventeen minutes' rubbing with wet finger, another in twenty-two minutes; on the tenth day two others, one in fourteen and the other in eight minutes; and on the eleventh day several were hatched, the time varying from two to five minutes of subjection to the saliva and friction. On the twelfth day it required but one or two minutes, and on the thirteenth eggs would hatch in fifteen to thirty seconds. On the fourteenth day a number of eggs were tried, about one-third of which hatched almost immediately upon being touched with the moist finger, the others in from five to eight seconds. On the fifteenth day all eggs seemed fully mature, and probably nine-tenths would have hatched at once upon being touched by a horse's tongue in the ordinary motion of licking. From the sixteenth day to the twenty-second the eggs would open with a touch of the finger, but the larvae would not adhere except with moisture. On the twenty-third day the first dead larva was noted, and a day later four out of eleven eggs opened had dead larvae. On the twenty-fourth day all of the eggs not previously opened were examined with a lens, and only one showed the cap removed, the larva being partly out but dead. The hatching of but one egg out of three hundred seems to me to establish pretty fully my former opinion, that the eggs require moisture or friction for the release of the young.

On the twenty-fifth day, out of ten eggs, three contained dead larvae, five could move slightly, and two were quite active. On the twenty-sixth day caps were removed from thirty-five eggs, twenty-seven larvae being dead, seven were capable of slight movement, and one was active enough to escape from the shell.

On the twenty-seventh day out of forty-three eggs opened only one larvae was alive, and on the twenty-eighth day only one out of sixty-five, and on the twenty-ninth day all the remaining eggs, one hundred and three, showed only dead larvae.

The results of this study it will be seen, confirm in the main the conclusion of the former observations, the principal difference lying in the fact that all the larvae were dead at a somewhat earlier period. Of course it could not be said that of the eggs opened in the earlier days none would have survived longer than four weeks, but considering the number used, and that one-third of them were kept the full four weeks and two-thirds nearly that long before being opened, the presumption is strong that that is the full normal period of survival.

It is safe, I think, to sum up the matter by saying that the eggs normally require friction and moisture to permit of their hatching and transfer to the horse's mouth, that hatching occurs with difficulty before the tenth day, and most readily after the fourteenth day, and that they lose vitality at a period varying between the twenty-eighth and fortieth days, the bulk not surviving more than four weeks. This gives a solid foundation upon which to base recommendations as to the time when eggs must be destroyed."

Before describing my own experiments, I should like very briefly to deal with the views advanced by the above.

Verrill's statement that larvae are present in the egg when laid I consider not entirely accurate. It is possible, indeed probable, if after the fertilization of the eggs dull weather follows and the ova are retained for some time within the parent, that this may be the case, as I have recorded for *Oestrus ovis,* Linn.,[1] and, further, I have an egg taken from a torpid female, in which a fairly well-developed larva is present, still in the ordinary course of nature I think we are not warranted in stating that the eggs contain larvae when laid.

The further statement that " moisture hatches the eggs " is scarcely correct in the light of Osborn's experiments and those recorded here.

Froggatt's statements that the eggs are carried to the mouth and hatch there is certainly wrong, and that of Bracy Clark's that the " warmth and moisture is sufficient to bring forth in an instant the latent larva," I am unable to verify.

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[1] Journ. Econ. Biology, 1906, vol. i, pp. 72, 73.

A view largely held by farmers and others that the larvae hatch and creep about the skin, is also without any supporting evidence.

So far as I can learn Osborn (*op. cit.*) was the first to definitely establish the fact that the eggs were not taken into the horse's mouth, and that in addition they required friction in addition to warmth and moisture. In his experiments, however, he does not seem to have taken into consideration the possibility of newly-laid eggs containing larvae.

The object, therefore, of the experiments here recorded is to verify or otherwise those made by Osborn.

A. The first batch of eggs were taken a few hours after being deposited.

1. A number of hairs with eggs attached were placed in a glass jar in which a damp sponge was suspended from the rim of the jar, but not in contact with any of the eggs. A temperature of 80° to 85° F. was maintained by means of a water batch. On the twenty-third day two eggs hatched and twenty-two remained unhatched on the fortieth day. When examined the larvae were all found to be dead.

2. The above experiment was also tried with eggs from batch A, leaving out the damp sponge. On the twenty-second day two eggs hatched, and the remainder were kept under observation for nearly five weeks, but no further hatchings took place.

3. A third experiment was made with some of the eggs of batch A as follows: A bundle of the hairs were tied together and tied to a piece of canvas tacked on to a piece of wood, which was allowed to hang outside exposed to the rain and sun. There were fifty-seven eggs, and at the end of twenty-one days only one egg was observed to have lost its operculum. They were examined daily to the end of the eighth week, when fifty-four eggs remained.

4. A fourth lot of eggs, similar to batch A, and may therefore be included here, were tested by first fixing the hairs to a piece of cloth and carefully wiped over with a piece of close, damp sponge. One half of the eggs were left untouched until the thirtieth day. On the twelfth day five eggs hatched, and the larvae adhered to the sponge, on the fourteenth day fourteen hatched, on the sixteenth day twenty, on the eighteenth day nineteen, on the twentieth day twenty, on the twenty-fourth day four, and on the twenty-eighth day one, a total of

83. All the empty egg-shells were still adhering to the hairs, and there remained eleven dead eggs on the thirty-sixth day.

On the twenty-fourth day the second half of the eggs were treated and three hatched, on the twenty-fifth day two, and on the twenty-seventh day one. The method of carefully wiping over with the sponge was continued until the thirty-sixth day, but no further hatchings took place.

Summary.

From the foregoing observations it is concluded that :—

1. The egg of *Gastrophilus equi* (Fabr.), is provided with a pair of lip-like valves, by means of which it is firmly attached to the hair.

2. After the larva has escaped the egg-shell adheres for some considerable time to the hair.

3. The eggs are not taken into the mouth as stated by Froggatt.

4. My experiments confirm and supplement those of Osborn, although the actual dates differ somewhat, thus the largest number of eggs hatched from the sixteenth to the twentieth day, and none hatched after the thirty-sixth day.

5. Without moisture or friction very few eggs hatch.

6.—MISCELLANEOUS.

THE VERDICT ON THE ROOK.

During 1909 I conducted a somewhat extensive investigation upon the feeding habits of the Rook,[1] and some few observations upon the same may not be without interest to Midland agriculturists.

It should be pointed out that for a considerable number of years agriculturists have contended that the rook was doing considerable harm to their crops, which far outweighed any good it did in destroying injurious insects, millipedes, etc. On the other hand a large section of the Press and public claimed that it was a really valuable bird to the farmer, and that its destruction would be followed by great losses.

It is only natural to assume that farmers generally had a more intimate knowledge of the habits of this bird than the general public, but in order to definitely decide what the actual food consisted of, the Land Agents' Society suggested a thorough inquiry that should take count of the food from January to December, and in practically every county in England. In all 631 *post mortems* were made during 1909, to which were added the results of 58 made of birds shot in the Midland Counties during previous years, and 141 made on a Northamptonshire estate, so that the total number was 830.

The specimens were received from forty-five correspondents, four of whom reported the birds to be very abundant, thirty-four stated abundant, five not abundant, and two made no comment.

There is ample evidence that the rook has greatly increased during the past ten years, and it is common knowledge that where bird-life increases in this manner over a number of years, there is usually a change in the food-habits, and this is exactly what has taken place in the case of the rook. From an insect-eating bird, or at least a bird whose food consisted mainly of animal matter, it has become a grain feeder.

Of the 631 rooks above mentioned the amount of animal food for the twelve months found in their gizzards was only 15 per cent. of the total food contents. Seventy per cent. consisted of grain, 15 per cent.

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[1] Journ. Land Agents' Soc., 1910, vol. ix, pp. 183-201.

of seeds, fruits, roots, and miscellaneous vegetable matter. Of the animal matter 4 per cent. was wireworms, 4 per cent. of other insects (mostly injurious), 1 per cent. millipedes, 2 per cent. earthworms, and 4 per cent. of a miscellaneous character, including eggs, young game, field mice, etc.

The results of this investigation, embracing a consideration of the stomach contents of 830 rooks, shot throughout the year 1908-9, throughout England and Wales, show :—

1. That 67.5 per cent. of the food of the rook consists of grain ; if to this we add that of roots and fruits, the percentage is raised to 71 per cent.

2. The animal food content was only 29 per cent., of which quite one-third must be reckoned against the rook.

3. There is ample evidence to show that with the present large numbers of rooks, a grain diet is preferred.

4. So far as the evidence of this inquiry shows, the rook is not a particularly beneficial bird to the agriculturist, although its usefulness might be considerably increased were it fewer in numbers.

In writing of the birds that injure grain in the United States of America, Mr. F. E. L. Beal[1] states " If it be admitted that birds do not as a rule display an inordinate appetite for grain, the question naturally arises : What is the cause of the tremendous ravages they sometimes commit? Both stomach examination and field observation point to the same answer : Too many birds of the same or closely allied species are gathered together within a limited area."

No words could be more pertinent than these in respect to the above mentioned inquiry, the verdict in short is—*we have too many rooks,* indeed one might go further and state that we have *far too many of a number of species* of wild birds which are distinctly destructive to cereal and root crops, game, etc., and it is necessary that they should at once be systematically reduced in number and held in check.

BULLFINCHES AND FRUIT TREES.

Some few years ago I expressed the view that in spite of all that had been said and written to the contrary, the bullfinch seriously damages fruit trees in the earlier part of the year.[2]

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[1] Year-book of the U.S. Dept. Agric., 1897, p. 353.
[2] 3rd Rpt. on Inj. Insects, 1906, p. 51.

Since then numerous observers have written me supporting this statement, in addition to which I have been able to make a careful *post mortem* examination of a large number of birds and to examine the stomach contents in detail.

All the birds were sent in during April and May in 1907-10, the total for the four years being 176, or an average of 44 birds per season. In not a single case was there anything present in the stomach beyond fruit-buds. From all parts the same conditions have been experienced. In some cases it has been bush fruits that have suffered, and in others fruit trees generally.

One observer writes : " I wish you had continued your investigation beyond the months of April and May, for in my experience they continue to damage the young fruit during June and July. For years I have systematically examined their stomach contents and cannot say a word in their favour.

In such cases as this every encouragement should be offered to schoolboys and others to collect the eggs. Our County Councils might do worse than offer prizes for the largest collections."

VOLES DAMAGING PARSNIPS.

Specimens of damaged parsnips have been received from a Staffordshire correspondent; these consisted mainly of the crowns of the roots which had been eaten out in a curious manner by the short-tailed field vole (*Microstus agrestis*).

This species has considerably increased in the Midland counties of recent years, and wherever it becomes at all plentiful it always proves injurious to farmers.

The ruthless destruction of owls and the kestrel, all of which prey upon voles, has much to do with the increase of these animals. It cannot be too widely known that the short-eared owl, the barn owl, and the kestrel feed very largely upon voles and mice and should be protected.

The Departmental Committee, appointed by the Board of Agriculture in 1892 to inquire into a plague of field voles in the south of Scotland, say in their report that they " were of opinion that it would be difficult to condemn too severely the foolish and cruel action of those who allow or encourage the destruction of this useful and

beautiful bird, and it was with much satisfaction that they were able to record that many landowners and game preservers had become convinced in late years that owls of all sorts are not only harmless to game, but most beneficial to agriculturists, and had issued orders for their preservation."

WEEDS ON GOLF GREENS.

The years 1908 and 1909 have been exceptionally favourable to the increase of weeds. During 1909 a detailed investigation has been conducted with a view to ascertaining the cause or causes of the deterioration of the Greens on a Golf Course, and the rapid increase of weeds.

Unless well laid down at the outset, Greens that bear a lot of play very soon deteriorate, due to numerous causes, amongst which may be mentioned bad drainage, heavy rolling, wrong top-dressings, lack of proper plant food, sourness or acidity of the soil, etc.

Amongst the weeds complained of in the case here referred to the following were the worst, and on some of the Greens had overpowered the Fescue and other fine grasses, the result being slow and uncertain playing Greens.

Crowfoot.	*Ranunculus bulbosus.*
Mouse-Ear Chickweed.	*Cerastium triviale.*
Mouse-Ear Chickweed.	*Cerastium arvense.*
Sandwort.	*Arenaria tenuifolia.*
Ladies Bedstraw.	*Galium verum.*
Daisy.	*Bellis perennis.*
Yarrow.	*Achillea millefolium.*
Dandelion.	*Taraxacum officinale.*
Greater Plantain.	*Plantago major.*
Hoary Plantain.	*Plantago media.*
Ribwort.	*Plantain lanceolata.*
Sheep's Sorrel.	*Rumex acetosella.*
Annual Meadow Grass.	*Poa annua.*
Dutch Clover.	
Various Mosses.	

Every course requires individual treatment, in the case referred to, a change in the top-dressings, systematic cross raking, seeding, light rolling, liming, and a richer food supply have resulted in a great improvement, and if the recommendations made are carefully carried out, there is no reason why within a very few months the Greens should not all be in excellent playing condition.

In golf greens and bowling greens, delay in ascertaining the cause of deterioration frequently demands, in the long run, expensive measures, whereas taken in time some simple treatment would prove effective.

APPENDIX A.

Instructions for using Hydrocyanic Acid Gas.

This, the most powerful and dangerous poison used in combating insect pests, should on no account be used by uninstructed or careless people.

The materials required are a 2 lb. pot jam-jar, in which place 7 ozs. of water, to which add 4 ozs. of sulphuric acid and, as directed below, 2 ozs. of 98 per cent. cyanide of potassium for every 1,000 cubic feet of space.

First make the room to be fumigated as air-tight as possible, leaving one window to open from the outside. Then wrap up the pieces of cyanide in blotting-paper. Having placed in the jam-jar the water and acid, place the jar just within the room to be fumigated, draw the door nearly to, and with the arm reach in and drop the wrapped-up cyanide into the jar, and close the door immediately. Strips of paper well sized should then at once be placed over the crevices.

The room should remain closed for from two to three hours; then open the window from the outside, and leave until thoroughly well ventilated. Remember the fumes and the cyanide are deadly poison. Care should be taken that no one remains outside the door of the room as in a passage, as some of the fumes might escape.

In conservatories, greenhouses, etc., proceed as follows:—Add the 4 ozs. of sulphuric acid to the 7 ozs. of water in a jar; then take the cyanide, which should be wrapped up in a blotting paper, and by means of a stick or piece of string drop it into the water from the outside of the greenhouse. The window or door should then be shut, and the house should remain closed for three-quarters of an hour at least, after which time they can be opened to ventilate, but it should be remembered that it is unsafe to enter the house until an hour or more after the windows and doors have been opened. The best results have been obtained at a temperature of 50° F., about one hour after sunset, when the foliage is dry.

Mr. G. F. Strawson informs me that he has obtained better results by pouring the diluted acid upon the cyanide of potassium, using no blotting paper. He has also devised and successfully used in conservatories, &c., a series of fans, consisting of boards suspended by two cords with a string on each side. The strings to the right and left are worked through a hole in the doors, or other woodwork.

AUTHORS

Quoted or Cited.

No author is justified in making statements "as though he himself had investigated and was responsible for the accuracy of these statements in virtue of his own observations on the objects described, when all the time he is simply stating what this and that man have seen, and he has not seen, though he omits to mention the name of those to whom he is indebted."

Sir E. Ray Lankester.

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