NOTES ON THE APHIDES OF THE CULTIVATED PEAS (PISUM SATIVUM AND LATHYRUS LATIFOLIUS) AND THE ALLIED SPECIES OF MACROSIPHUM.

By FRED. V. THEOBALD, M.A., F.E.S., Hon. F.R.H.S., etc.

(Plates XIV and XV.)

IN certain years the pea crop, both field and garden, suffers to a considerable extent from the attack of Aphis. This is not only the case in Europe but also in America. In Britain I have found three species feeding and breeding on peas, not only on the edible varieties but also on sweet peas, everlasting peas, and the Blue Pea.

By far the most general and serious enemy is the Green Pea Louse (*Macrosiphum pisi* Kaltenbach).

The other two are *Megoura viciæ* Kaltenbach and *Aphis rumicis* Linnæus. The latter has perhaps the widest range of food plants of all the Aphididæ, but it seldom does much damage to peas, and as I have treated it elsewhere nothing will be said concerning it here.[1]

The Green Pea Aphis (*M. pisi* Kalt.) has several close allies feeding on different plants, two of which were described as distinct species, but which since have been sunk as synonyms. I wish to show here that they are quite distinct species. This narrows down the great difficulties of preventive treatment, as if the Green Pea Louse bred on several very abundant wild plants, which grow in almost every wood and hedgerow, the possibility of checking this pest would be well-nigh insurmountable.

KALTENBACH, in describing *Aphis pisi* (*Mono. Pflanz.*, 23, 11), refers to *Aphis ulmariæ* Schrank (*Faun. Boic.*, ii., 111, 1221).

SCHRANK'S name *ulmariæ* has been adopted by WALKER, BUCKTON, SCHOUTEDEN, and others for the green *Macrosiphum* on the Pea, Meadow Sweet, Wild Avens or Geum, and other plants.

[1] *Journal Board of Agriculture*, vol. xix., No. 6, September 1912, pp. 466–76.

The synonymy given by WALKER (*Cat. Homop. B. M.*, 4, p. 966) is as follows:

Aphis ulmariæ Schrank, *Faun. Boic.*, ii., III, 1221.
Aphis onobrychis Fonscolombe, *Ann. Soc. Ent. Fr.*, x., 169, 9.
Aphis lathyri Mosley, *Gard. Chron.*, i., 684.
Aphis pisi Kaltenbach, *Mono. Pflanz.*, i., 23, 11.
Aphis pisum Harris, *Exposit. Engl. Ins.*, 66, Pl. 7, figs. 10–12.

And in the Supplement to the same work, p. 291:

Siphonophora gei Koch, *Pflanzenl.*, 171, 176, Pl. 321, figs. 234, 235.
Aphis ulmariæ, p. Cat. Hom., 966.

SCHOUTEDEN (*Cat. d. Aphid. Belg.*, *Mém. Soc. Ent. Belg.*, t. xii., p. 240) gives the following synonymy:

Macrosiphum ulmariæ Schrank.
destructor Johnson.
gei Koch.
lathyri Walker.
onobrychis Fonscolombe.
pisi Kaltenbach.

BUCKTON (*Mono. Brit. Aphid.*, i., p. 133) retains KALTENBACH'S name, giving the following synonymy:

Siphonophora pisi Kaltenbach.
Aphis ulmariæ Schrank.
Aphis onobrychis Fonscolombe.
Aphis pisi Kaltenbach.
Aphis lathyri Walker, Mosley.
Siphonophora pisi Koch.
Siphonophora ulmariæ Passerini.

FERRARI (*Aphid. Liguriæ*, p. 54) gives the following synonymy:

Siphonophora ulmariæ Schrank.
A. onobrychis Fonscolombe.
A. pisi Kaltenbach.
S. gei Koch.

KALTENBACH (*Mono. Pflanz.*, p. 23) in describing *Aphis pisi* says it lives in July on *Pisum sativum* and *P. arvense*, on *Lotus uliginosus*, *Ononis repens*, and *O. hircina*, on *Trifolium pratense* and *T. filoforme*, on *Lathyrus odoratus*, *Spartium scoparium*, *Colutea arborea*, *Geum urbanum*, *Spiræa ulmaria*, *Ephilobium montanum*, *Chærophyllum temulum*, *C. sylvestris*, etc.

Evidently from this list KALTENBACH had confused several species, owing to their similarity in colour and form.

SCHOUTEDEN (*Cat. Aphid. Belg.*, p. 240) gives as food plants for *M. ulmariæ* Schrank the following: *Colutea arborescens, Genista tinctoria, Robinia pseudacacia, Trifolium* var. sp., *Spiræa ulmaria,* etc.

FERRARI (*Aphid. Liguriæ,* p. 54) gives as food plants "*Geo urbano, Rosis cultis,* et *Hyosieride radiata.*"

BUCKTON (*Mono. Brit. Aphid.*, i., p. 135), besides saying it affects a large number of plants besides the pea, also says "The glaucous female in Pl. XIV was taken on the common nettle *Urtica dioica.*"

The specimen figured is evidently not KALTENBACH'S *pisi* at all. DAVIDSON (*Journ. Eco. Ent.*, iii., p. 380) also mentions it as occurring on *Urtica holoserica.*

From a careful examination of the Green Aphides of the Genus *Macrosiphum* (formerly called *Siphonophora*) found on the Meadow Sweet (*Spiræa ulmaria*), the Avens (*Geum urbanum*), the Peas (*Pisum* spp.), Bird's Foot Trefoil (*Lotus corniculatus*), and Stitchwort (*Stellaria graminea*), I find they are all distinct and well-marked species. The Green Aphis on the Rest Harrow (*Ononis arvensis*), the *Siphonophora ononis* Koch, is also evidently quite distinct, judging from a single alate specimen I have.

All these Aphides bear a very strong resemblance to one another, so much so that one can quite imagine KALTENBACH and others grouping them together.

When, however, one examines the structure and ornamentation of the antennæ and cornicles, marked differences can be seen between certain of them.

In the alate females these characters are most marked; the number and disposition of the sensoria of the antennæ and the sculpturing of the cornicles are easily demonstrated in specimens mounted in Canada balsam, and this also applies to the apterous females, but not quite to the same extent. In the nymphæ these characters are frequently absent, however.

We can divide this group of *Macrosiphum* primarily into two:

A, the *pisi* group, in which the cornicles are entirely imbricated, and sensoria occur on the third antennal segment. These

I have only found on Papilionaceæ. In this group come *pisi* Kaltenbach, *ononis* Koch, and apparently two new species which I propose to call *loti* and *trifolii*.

B, the *ulmariæ* group, in which the cornicles are reticulated at their apices and again have sensoria on the third antennal segment only. In this group come *ulmariæ* Schrank, *gei* Koch, and *stellariæ* nov. sp.

Group A.

Species I. *Macrosiphum pisi* Kaltenbach (Pl. XIV, fig. 1, fig. 2 C).

Aphis pisi Kaltenbach.
Siphonophora pisi Koch.
Nectarophora destructor Johnson.
Aphis onobrychis Fonscolombe.
Aphis pisum Harris.
Aphis destructor Patch.
Aphis lathyri, Walker, Mosley.
Nectarophora pisi Sanderson.

This is the common Green Pea Louse found all over Europe and America, and I have had specimens sent me from Natal. The general colour of the insect is green, varying from pale apple green to grass green in all stages. I have never found pink forms.

Wingless Viviparous Female.—Green, roughly spindle-shaped and elongated, smooth and somewhat shiny ; eyes red ; abdomen showing sometimes six darker spots on each side.

Legs green to yellowish green with dusky apices to femora and tibiæ and dark tarsi. Tail ensiform, long ; antennæ very long, pale yellowish green, the apices of the segments dark, sixth segment mostly dark ; the fourth about three-fourths the length of the third, fifth not quite as long as the fourth and fifth together ; the third has two or three sensoria at the base. Cornicles pale green, dusky at the apex, long and thin, but not reaching beyond the long tail, imbricated along the whole length. *Length*, 2·2–2·9 mm.

Winged Viviparous Female.—Green of various shades, some very pallid, others apple green or grass green, with sometimes

a mealy coat, others shiny. Eyes red to black. Antennæ very long, similar to the apterous female, but usually somewhat darker, colours varying from pallid yellow to green or olive green. Cauda long and ensiform, but not so long as in the apterous female in some specimens. Cornicles long and thin, often reaching as far as the cauda, pale green to yellow green, dusky just at the tip, imbricated for their whole length.

Fourth antennal segment not quite as long as the third, the third with a line of 12 to 16 sensoria not reaching the apex, fifth about as long as the fourth, no sensoria on the fourth or fifth; sixth as long as the fourth and fifth or slightly longer, all the segments faintly striate.

Wings with yellowish stigma, varying to yellowish green.

In some specimens the thoracic lobes are slightly darkened.

Length, 2·5 to 3·3 mm.; wings 9·0 to 9·4 mm.

The Pupa.—This stage is much like the apterous female, but the wing-cases are dusky at the apices, and there is now and then somewhat darker mottling and a darker green dorsal line. Like the former, the skin may carry a mealy covering. The third antennal segment shows no sensoria, and the cauda is shorter and broader.

This species occurs on peas from May until August, but the majority do not occur on the peas until they are well in blossom.

Species 2. *Macrosiphum loti* nov. sp. (Pl. XIV, fig. 2 A).

Apterous Viviparous Female.—Similar in colour to *pisi*, but the cornicles are relatively much longer and thinner, the cauda shorter, and the third segment of the antennæ has a single reniform sensorium near the base.

Found only on *Lotus corniculatus* in July and August at Wye. They are found on the leaves, and also cluster in dense masses on the green seed-pods. They fall readily when on the pods, but hold more tenaciously to the leaves. I have never been able so far to breed the alate form, but nymphæ have been obtained.[1] The single sensorium at once separates it from true *pisi*. Specimens transferred to late garden peas did not live on them.

Species 3. *Macrosiphum trifolii* nov. sp. (Pl. XIV, fig. 2 B).

[1] Since this went to press the alate female has been found, and is being described in the *Journal of Economic Biology*.

Apterous Viviparous Female.—Very similar in colour to the two former, but usually a paler green, the antennæ relatively thicker, the fourth segment nearly as long as the third, the fifth as long as the fourth, no sensorium on the third.

Found on *Trifolium procumbens* the first week in August, breeding in small numbers amongst the flower-heads at Wye and Hastings. I also transferred these to peas, but the colonies soon died out.

GROUP B.

Species 4. *Macrosiphum ulmariæ* Schrank (Pl. XIV, figs. 3 and 6).

Winged Viviparous Female.—Various shades of green with mealy coat in most cases. The head, antennæ, legs, and cornicles slightly darker than in *pisi*. The green legs have a larger dark area at the apices of the femora and tibiæ, and the tarsi dark. The ensiform cauda is pale yellowish green, and the cornicles are relatively thicker than in *pisi*; moreover, their dusky apices are markedly reticulate, and there are some apparent transverse lines below, but no imbrication.

The third antennal segment has a line of sensoria varying from 14 to 19 on one side; remaining segments without any sensoria.

Length, 2 to 3 mm.; wings 9·2 to 9·8 mm.

Apterous Viviparous Female.—Green of various pale shades, often with a mealy coat. Antennæ about as long as the body, apices of third, fourth, and fifth, and all the sixth segment dusky, fourth slightly shorter than the third, fifth about equal to the fourth, no sensoria on the third. Cornicles green, dusky at the apex, showing faint reticulation. Cauda pale yellowish green, shorter and blunter than in the alate female. Legs all yellowish green, except the tarsi.

Length, 2·5 to 3 mm.

Nymph.—Like the above, the wing-tips being slightly dusky.

A pink variety occurs side by side with the green and produces exactly the same winged females. The only difference is that in the pink forms the apices of the tibiæ are dusky.

This species I have found in many places in Kent, Sussex,

Surrey, Hampshire, and Huntingdonshire, and I have taken it in Devonshire, Cornwall, Worcester, Hertfordshire, and Shropshire.

It lives in dense clusters up the flower-stalks of the Meadow Sweet (*Spiræa ulmaria*), usually one closely fixed behind the other. They are very timid and fall to the ground at the least shock in all stages, whilst I have found that *M. pisi* sticks fairly tenaciously to the pea when young, but by no means always. I have found this Aphis from May to June as apterous females; nymphæ commence to appear from the first week in June and alate females from then on to July, when it disappears from the Spiræa. Frequent trials to plant this Aphis on cultivated peas at various times have always ended in failure.

Species 5. *Macrosiphum gei* Koch, *Siphonophora gei* Koch (Pl. XIV, figs. 4, 7 B).

Winged Viviparous Female.—Green and very similar to the former; the antennæ are darker and the legs may be a darker green than in the former, there being a dark area at the apex of the femora and tibiæ and dark tarsi, and the thoracic lobes may be darkened. The ensiform cauda is yellowish green; the cornicles are green with dusky apex, which is reticulate, and below are a few transverse lines. Third segment of antennæ with 14 to 16 sensoria in a line extending for rather more than half the length of the segment, none on the remainder.

Wingless Viviparous Female.—The cornicles the same as in the alate form. The third segment of the antennæ with three sensoria near the base. Cornicles dark at their apices.

Nymph.—Cornicles imbricated for their whole length, and darker than in the other two stages. Antennæ without sensoria on segment three. Wing-buds dark brown and cornicles dark.

Abundant in Kent, Surrey, Sussex, Hampshire, Hertfordshire, and Essex on the Wild Avens (*Geum urbanum*), forming dense clusters up the flower-stalks closely packed together. They fall readily, as does the previous species. This species occurs from the end of April through into June. Nymphæ appear at the end of May, winged females in June, and by the first week in July they have mostly left; all have gone by the second week. I have never been able to take them on the wing or find an alternative host plant.

Many attempts have been made to plant this Dolphin on

cultivated peas, but the colonies soon died off, the young produced by the alate females only living a few days.

Species 6. *Macrosiphum stellariæ* nov. sp. (Pl. XV, figs. 5, 7 C).

Wingless Viviparous Female.—Pale green to apple or grass green, very like *pisi*; but the antennæ not so long and the cornicles thicker.

The cornicles are green with dark apices, apices reticulate, remainder with a few transverse striæ.

The third segment of the antennæ has a group of five or six sensoria near the base, and the fifth and sixth segments are dusky.

Found in abundance at Ecclesbourne Glen and other places near Hastings, and once at Wye on the Stitchwort (*Stellaria graminea* Linn.). A few apterous females found at the end of April, and by May 15th these had produced a goodly progeny. The females sheltered between the leaves, and owing to their colour were difficult to detect. I failed to find more than one small colony at Wye, and these died off before any winged brood was produced. It is clearly distinct from the other green Macrosipha and is in no way connected with the Green Pea Louse (*M. pisi* Kalt.), owing to the reticulate cornicles, and differs from *gei* Koch and *ulmariæ* Schrank in the arrangement of the sensoria on the third antennal segment.[1]

Notes and Observations on the Distribution, Habits, Food Plants and Life Cycle of Macrosiphum pisi Kaltenbach in Britain.

The Green Pea Louse or Dolphin I have definitely found on the following plants in Britain: all varieties of cultivated culinary and ornamental peas (*Pisum*), on the wild Everlasting Pea (*Lathyrus sylvestris*), on cultivated *Lathyri*, on Red Clover (*Trifolium pratense*), White Clover (*T. repens*), Alsike Clover (*T. hybridium*), and on the Shepherd's Purse (*Capsella bursa-pastoris*).

It usually appears on the garden and field peas in late May,

[1] Since this paper went to press I have found the alatæ at Bramley in Surrey and at Little Hadham in Hertfordshire.

June, and early July, and goes on until the end of August, and I have found a few as late as September 12th. The winged females leave the dying peas and fly to the wild Everlasting Pea (*Lathyrus sylvestris*) and the cultivated garden Everlastings and also to clover, where the sexuparæ are later produced. The ova I found were laid low down on the haulm, close to the ground as a rule, but some on any part of the plants. At first they are green, but in a few days assume the black shiny colour so characteristic of Aphis eggs. In 1907 I found the ova hatching on March 27th, at which time the Everlasting Peas were first shooting above the soil. The same happened on clover, where the majority seem to winter and live until they migrate to the peas and set up the summer progeny. Normally their autumn, winter, and spring habitat in this country is clover and the wild *Lathyrus sylvestris*. The colonies I have found on the Shepherd's Purse (*Capsella bursa-pastoris*) in the autumn have never survived. PATCH (*Bulletin* No. 190, Maine Agricultural Experiment Station, U.S.A.) was unable to get this Aphis to live on *Trifolium pratense*, but was able in August to get them to breed on Shepherd's Purse, but no mention is made of the sexuparæ. Various other plants were tried by Miss PATCH, such as barley, wheat, oats, purslane, beets, and squash, but the colonies all died out.

In 1910 I placed colonies on willow, raspberry, clematis, clover, and Lathyrus, and only on the two latter did they continue to breed until the autumn, when an oviguous race was produced.

This, then, narrows down the list of summer and winter host plants, and so by the destruction of the perennial wild peas, and the feeding off of clover prior to migration, much may be done to lessen the damage that in certain years is very serious.

GENUS MEGOURA Buckton.

Megoura viciæ Kaltenbach, *Aphis viciæ* Kaltenbach.

This insect was described by KALTENBACH (*Mono. Pflanz.*, p. 20, 1843) as feeding on *Vicia sativa*, *V. sepium*, *V. angustifolia*, and *V. faba*, also on *Lathyrus pratensis* from June to September.

I have found it in abundance on garden peas, the colonies

mixing with those of *Macrosiphum pisi* Kalt. in some cases and in others alone. It also now and then occurs with the Black Dolphin or Collier (*Aphis rumicis* Linn.) on broad beans in a similar way. In those districts where I have known it, near Great Staughton in Hunts and at Wye in Kent, and years ago at Kingston-on-Thames in Surrey, it was always common on *Lathyrus sylvestris*. Last year I removed a colony from the latter plant in June and placed them on peas and broad beans in my garden. They flourished to an alarming extent on both plants. Those on the beans became winged in July and left. Watch was kept on two large masses of Lathyrus in the neighbourhood, and I found that from June 30th to July 20th winged females appeared, and from then onwards I saw no trace of them on the peas. From that date onwards these insects flourished on Lathyrus as in the spring, and in November I found ova low down on the haulm. It is thus clear that this handsome Dolphin also migrates between the wild Everlasting Pea (*Lathyrus sylvestris*) and the cultivated peas and beans. I tried to cultivate the summer brood from peas on clovers, and on a white Everlasting Pea a variety of *Lathyrus latifolius*, but without success.

These two cases show what we may naturally expect—that the insects of this group found on the annual plants pass the winter on the perennials so as to ensure their continuity of existence.

Moreover the host plants do not seem to be very varied, and certainly do not pass out of the Papilionaceæ, as we see is done by the third species sometimes found on the peas, the Black Fly, or *Aphis rumicis*, which has such a vast number of food plants, ranging from the dock and onion to the mangold, bean, poppy, and chamomile, and even apples.

Buckton (*Mono. Brit. Aphid.*, i., 188) placed this Aphis in a new genus, *Megoura*, which was certainly justified.

Schouteden (*Cat. Aphid. Belg.*, p. 240) sinks this genus under *Amphorophora* Buckton, in which I cannot agree, as Buckton's type of the latter genus—*Amphopophora ampullata* Buckton, is an insect of totally different facies.

Buckton says his *M. viciæ* is certainly neither Koch's *Siphonophora viciæ* nor Kaltenbach's *Aphis viciæ*. I am fully

in agreement with SCHOUTEDEN that it is only KALTENBACH's species.

BUCKTON's specimens were obtained from Keteringham, some few miles distant from Norwich, where Mr. Barrett found them during two successive Septembers feeding on the green seed-pods of the Vetch, *Vicia sepium*. I have only found it at Wye and Faversham in Kent, and at Widdington in Essex, in any numbers, on cultivated peas.

The object of this paper is to show that *Macrosiphum pisi* of KALTENBACH is a distinct species, and to reinstate KOCH's *Siphonophora gei* at the same time, and above all to fix the identity of the European Green Pea Louse, which is not the *ulmariæ* of SCHRANK, but the species described by KALTENBACH as *pisi*.

SOME PREVIOUS OBSERVATIONS OF THE PEA APHIDES.

CURTIS (*Farm Insects*, p. 493) refers to the Pea Aphis as *Aphis viciæ* Fabricius and *A. pisi* Curtis.

He found a green Aphis in abundance in May and June on vetches, and in mid-June on grey peas; in the beginning of July winged females appeared, "and were no less plentiful on the bloom," says CURTIS.

CURTIS refers to the winged male as being black or brown; antennæ longer than the body; femora and tibiæ more or less yellow towards the base.

This is evidently not the male of *M. pisi* Kalt., and is probably *Aphis rumicis*.

ORMEROD (*Ninth Rept. Inj. Ins.*, p. 62, 1886) refers to a bad attack at Kingsnorth, Kent, the Dolphin appearing about the time the first flowers expanded. On July 24th the peas were cut, and it was noticed that the Aphides fell until the ground was covered with them, and they crawled up every available plant, giving a superficial resemblance to the green flower-head of some orchidaceous plant. The insects nearest the stem were noticed to be lice, closely packed, frequently two or three layers thick, and then outside these a coat of "fly," with their heads all pointing upwards. Next day all the fly and the greater part of the lice had disappeared. Tares were also attacked.

LAMPA mentions this Aphis as harmful in Sweden (*Uppsatser Praktisk Entomologi*, 17, p. 5, 1907).

It was recorded for the first time in America from Maine, along the Atlantic coast southwards to North Carolina and westwards to Wooster, Ohio, in 1899, and was also observed in Nova Scotia and Ottawa, Canada (Notes upon the destructive Green Pea Louse (*Nectarophora destructor*) for 1900, *Bull.* 26, N. Se. U. S. Dep. Agri. Div. Ent., p. 55, 1900). JOHNSON also recorded it from Massachusetts and Vermont in July and August, and also from Chillicothe, Ohio, Long Island, N.Y., portions of New Jersey, and Wisconsin, in August.

JOHNSON, who first observed this pest in May 1899, described it as *Nectarophora destructor* in the *Canadian Entomologist* (February number).

JOHNSON refers in this paper to the great damage done to both red and crimson clover, and he considers red clover its original food plant and thus thinks it primarily a clover pest.

In the south he found it spent the winter in the adult state in clover fields, but suggested that farther north it may pass it in another form.

NEWELL and ROSENFELD (*State Crop Pest Commission of Louisiana*, Circ. No. 27, p. 108, 1909) refer to its damage in Louisiana and to its wintering in the egg stage. They refer to it as *Nectarophora pisi* Kalt.

DAVIDSON records it from California on *Vicia* sp. (?), on cultivated beans, and on *Urtica holoserica* (*Journal Eco. Ent.*, iii., p. 380).

GILLETT took this Aphis on *Trifolium pratense* at Albany, N.Y., July 1st, and also received specimens from Maryland, and says it is very abundant in Colorado on both eastern and western slopes, where it was taken on the Garden Pea, *Lathyrus odoratus*, and Alfafa, *Melilotus alba*. He identified them from specimens taken by COCKERELL from Sussex, England, on peas in July 1909. His figures of the antenna and cornicle of the winged female agree with our European *pisi*, but the cornicle of the apterous female (Pl. XVI, fig. 24) certainly does not, as there is no trace of apical reticulation in true *pisi* such as he figures. He also mentions the sensoria at the base of segment three as varying from 2 to 5. I have never seen more than

three in any European specimen (*Journ. Eco. Ent.*, iv., p. 304, Pl. XVI, figs. 22–24).

FLETCHER has referred to this pest in Canada, saying tha in the summers of 1899 and 1890 it practically destroyed the whole of the crop of late peas from the Southern States and over the greater part of Canada, east of the prairies (*Insects Injurious to Grain and Fodder Crops, Root Crops, and Vegetables*, Bull. No. 52, p. 27, Dep. Agri. Ottawa, Canada).

FLETCHER gives a fuller account of this pest in Canada in his annual Report for 1899, pp. 170–74. In this reference is made to another kind of Aphis, attacking the roots of sweet peas, of a brick red colour.

He also refers to several kinds of predacious insects attacking the Green Pea Louse, including Lace-wing Flies, Lady-birds, Syrphus larvæ. Of Lady-birds the chief were *Hippodamia convergens* Guer, *Coccinella 9-notata* Herbst, the larvæ of *Syrphus ribesii* Linn.; also *Plaon cerasaphis* Fitch and *Aphidius fletcheri* Ashmead.

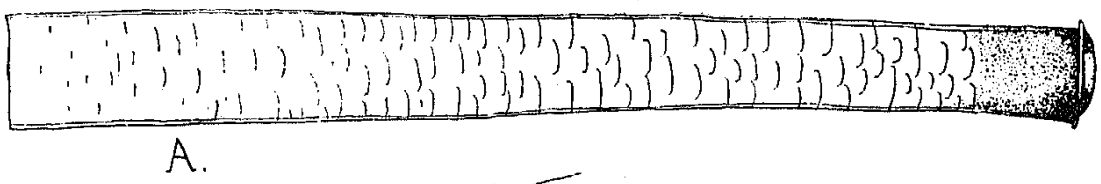
BIRDS FEEDING ON THE GREEN APHIS.

At Kingsnorth Mr. HART found that starlings came by hundreds to feed upon them, and to some extent willow wrens, white-throats, and the smaller tits (*Paridæ*). During a bad attack at Wye Court Farm in 1900 sparrows were noticed clearing off the "Green Dolphin" in company with hosts of starlings, also brown linnets, and had it not been for these birds the crop would have been more seriously damaged.

Treatment.—Two methods of treatment have been tried, namely (1) spraying, and (2) the brush and cultivator method.

Spraying can only satisfactorily be carried out in staked garden peas; dwarf varieties, like "William Hurst" and field peas, cannot be properly treated in this way. As a spray I have found soft soap and quassia at the usual strength quite sufficient to destroy them, but tobacco extract and soap certainly act more quickly.

The brush cultivator method used in America is scarcely likely to come into vogue in Britain, as it necessitates planting the rows of peas too far apart. One plan adopted in America is for two boys to walk along the spaces between the rows,



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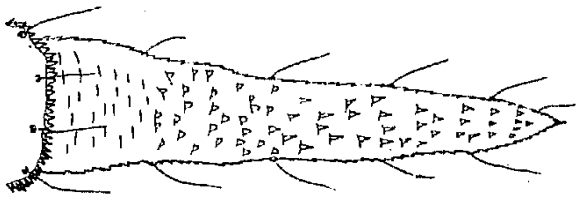

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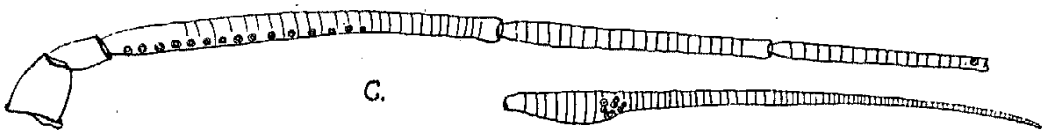

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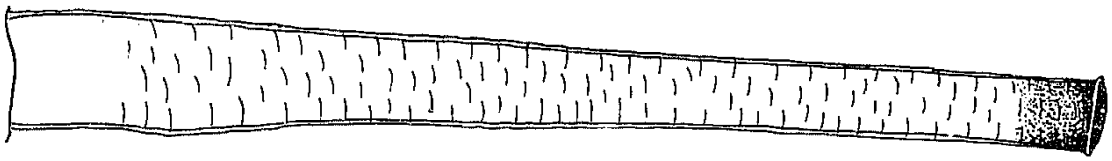

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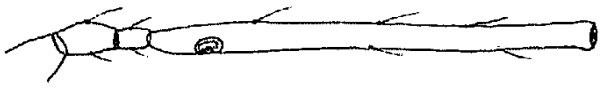
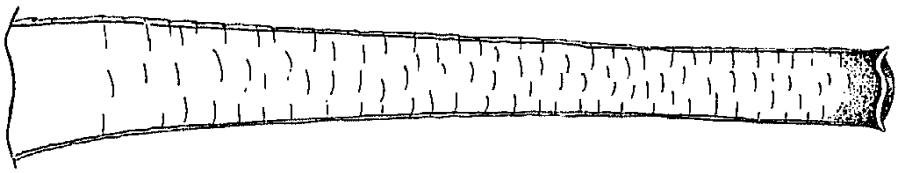


2.



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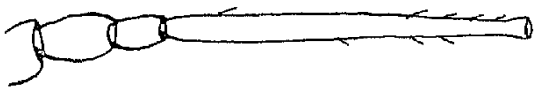

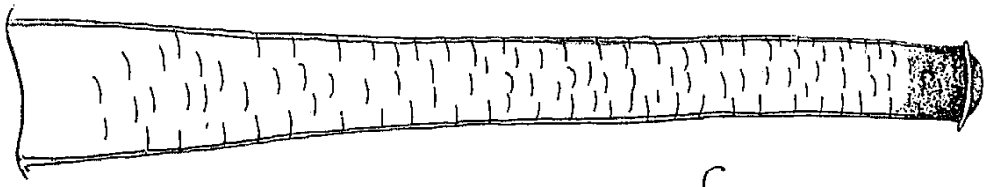

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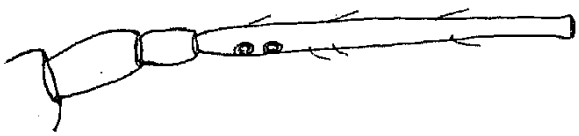

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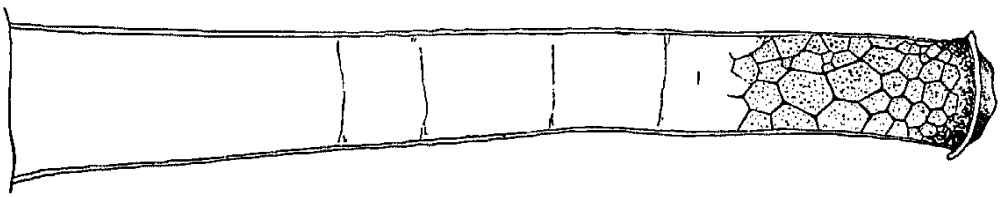

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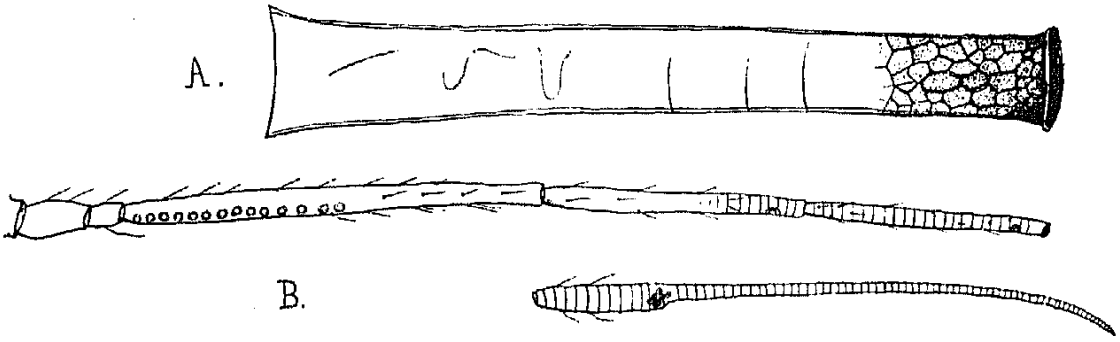

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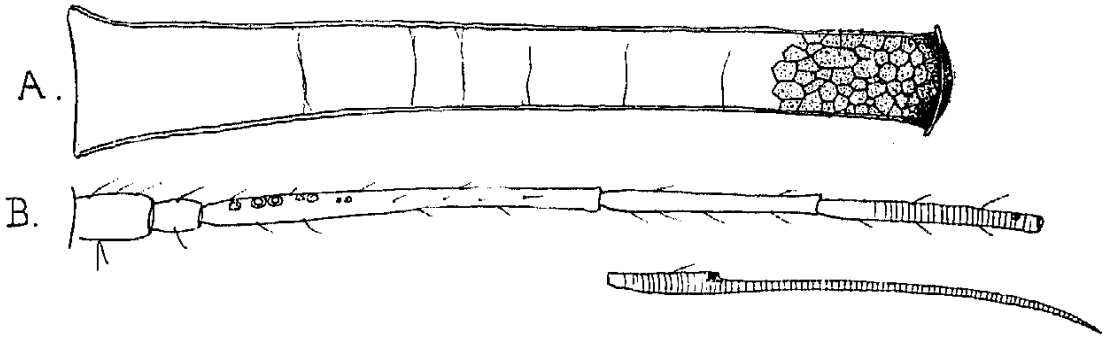

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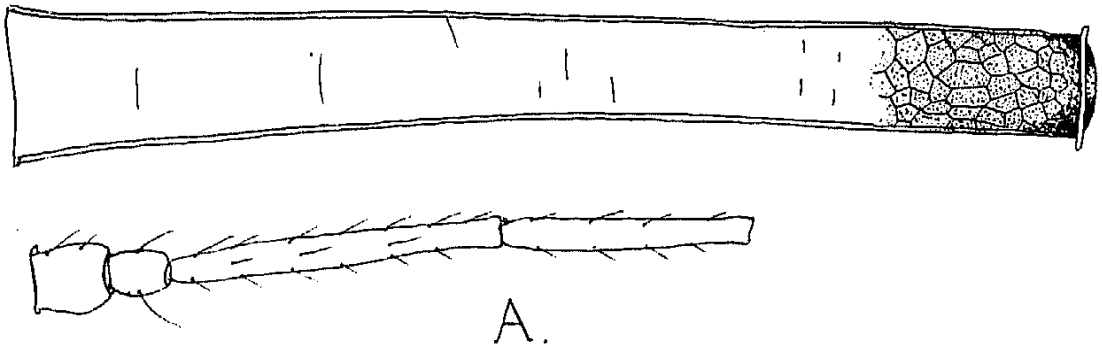

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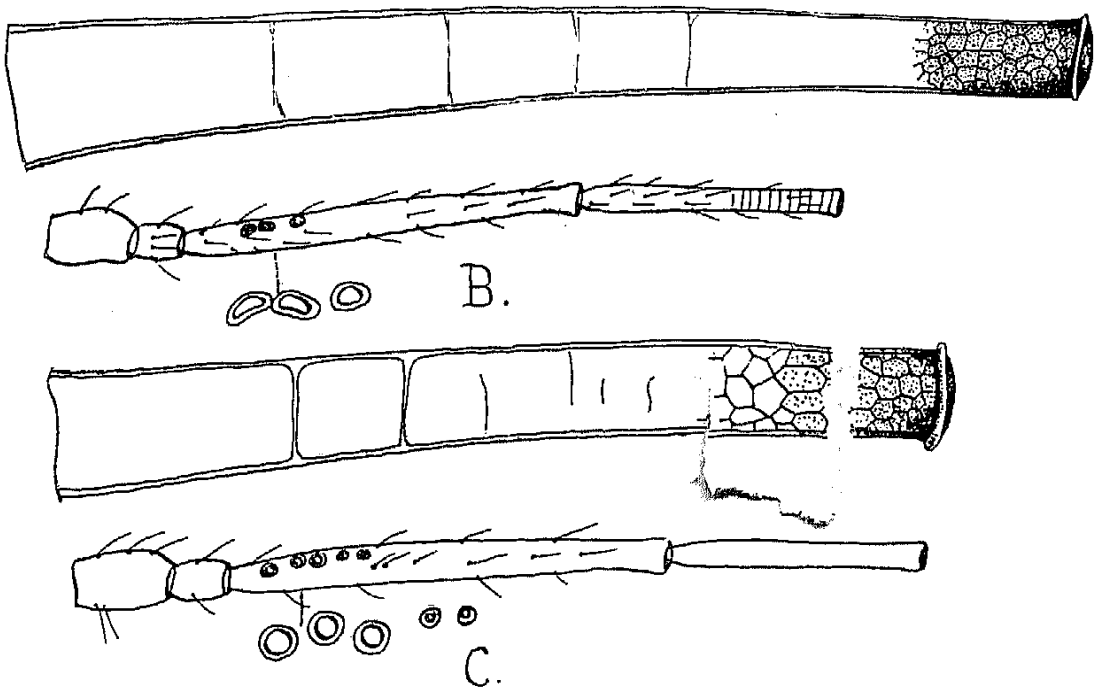

leaving one space between them; along this space follows a cultivator which destroys the Aphides. Even this has to be repeated at intervals if the lice continue to increase. These methods have been tried in England, and they are not found practicable owing to the different method of cultivation.

PL. XIV. Fig. 1.—*Macrosiphum pisi* Kalt., alate female.
A. Cornicle.
B. Cauda.
C. Antenna.
Fig. 2.—A. *Macrosiphum loti* nov. sp. apterous female.
B. *Macrosiphum trifolii* nov. sp.
C. *Macrosiphum pisi* Kalt.
Fig. 3.—*Macrosiphum ulmariæ* Schrank, alate female.
A. Cornicle.
B. Antenna.
Fig. 4.—*Macrosiphum gei* Koch, alate viviparous female.
A. Cornicle.
B. Antenna.

PL. XV. Fig. 5.—*Macrosiphum stellariæ* nov. sp.
Fig. 6.—*Macrosiphum ulmariæ* Schrank, apterous female.
A. Cornicle.
B. Antenna.
Fig. 7.—B. *Macrosiphum gei* Koch.
C. *Macrosiphum stellariæ* nov. sp.