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THE
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DESCRIPTIONS AND LIFE-HISTORIES OF TWO NEW PARASITES OF THE BLACK CURRANT MITE, *ERIOPHYES RIBIS* (NAL.).

By
ADELAIDE M. TAYLOR.

(From the Zoological Laboratory, University College, Reading.)

With Plates I and II, and 5 Text Figures.

The black currant mite is a pest only too well known to cultivators of bush fruits. Its wide distribution and the rapidity with which it invades a plantation causes its appearance in the orchard to be reckoned as an inevitable commercial loss. The full details of the life-history of this mite are as yet imperfectly understood, and the pest continues to increase rapidly. This is probably due to the want of this requisite knowledge. There are numerous animal parasites which prey on the mites, among which may be mentioned the larvae of the chalcid fly, hover fly, ladybird, and many predatory acarids. The majority of these, however, are of little importance in keeping the pest in check, for they can only exercise their predatory habits during the brief period of activity allotted to insects which pass the winter months in a dormant condition. The chalcid fly is an important exception, as will be seen from the account of its life-history given in this paper.

In addition to these natural enemies the mites are parasitized by a minute fungus, a species of *Botrytis,* hitherto undescribed, and closely allied to that which attacks the silkworm (*Botrytis bassiana*). This fungus, which is most deadly in its action on the mites, makes its appearance as a parasite when the buds begin to break unnaturally, owing to the depredations of the mites within. This usually occurs in the early part of the year, by which time the mites have increased to such an extent that the embryonic leaves immediately interior to the scale leaves teem with acarids. Spores of the fungus which are blown on the mites exposed by the bursting of the bud, germinate

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and fructify under suitable conditions. Rapid infection ensues among the surrounding acarids, and the disease spreads until the minute parasite has worked its way through the whole bud, killing not only the mites and their eggs, but the chalcid grub which lives among them.

A bud in which the mites have been parasitized by the fungus has a characteristic appearance. The flourlike covering due to the presence of the acarids on the embryonic leaves of a "big bud" disappears, and the grey, cottony, matted film, which takes its place, spreads over the leaves in a continuous layer. When this substance is examined with a microscope it is seen to be composed of numbers of dead mites bound together by the densely interwoven hyphae of the parasitic fungus. Many species of *Botrytis* are notorious for their facultative parasitic propensities, and an interesting feature in the life-cycle of this fungus is its power to become a saprophyte or parasite at will. The life-history of the mite renders this adaptation to circumstances compulsory.

The migratory period of the acarids takes place from April onwards, and from this time till the buds burst in the early part of the year the fungus cannot gain access to the mites through the densely adhering scale-leaves, unless indeed it is borne thither by an infected mite. For six months of the year then the fungus becomes saprophytic, living on the decaying tissues of the bud in which it had previously led a parasitic existence.

The following experiments were made to test the saprophytic nature of the fungus. The spores of a pure culture of the *Botrytis* grown on Agar were carefully dusted on the bud-leaves of trees belonging to widely different orders, and put in a moist chamber. As the leaves decayed the fungus grew vigorously and produced quantities of conidia. Mites and chalcid larvae were inoculated with these spores, and in every case they developed and succumbed to the parasitic *Botrytis*.

A description of the habits of the fungus will enable its life-history as a parasite to be more easily followed. A germinating conidium produces as growth proceeds sterile and fertile hyphae. The sterile hyphae are septate, creeping, vaguely branched, hyaline, and from 2-3μ in breadth. The fertile hyphae are erect and produce at definite intervals clusters of from three to six verticillate conidiophores (Pl. 1, fig. 3). The conidiophores are acutely pointed at the tip and each bears at its apex a cylindrical, erect, hyaline, continuous conidium, which measures from 5-8μ in length and from 1.5-2μ in breadth. When the fungus is growing

vigorously the long and fructifying branches above have a tendency to intertwine, and the resulting rope-like strands of interwoven hyphae become densely covered with powdery snow-white spores. The way in which the fungus attacks and destroys the mite is as follows : When a germinating conidium comes in contact with a mite, the germ tubes bore their way through the skin, and in most cases take a longitudinal course immediately beneath the cuticle. The fructifying sub-cutaneous hyphae produce at intervals whorls of conidiophores which are thrust through the skin of the mite. From three to six emerge in one spot, another cluster is produced at a short distance, and so on along the length of the fertile hyphae. At this stage of infection the mite is frequently alive. The explanation of this fact is that the thin skin of the acarid offers but little resistance to the exit of the conidiophores and hyphae, while the mycelium which penetrates the internal tissues is obliged to dissolve the fat bodies with which it comes in contact. It is not therefore till the ramifying hyphae have bored their way through the vital tissues that death of the mite takes place. Many of the spores abstricted from the conidiophores fall on the already infected body of the mite, where they germinate. By this means fresh centres of infection are produced, and the mite rapidly becomes a mass of short conidiophores and long fructifying hyphae, both of which give off a profusion of spores. Sterile hyphae are also produced in great quantities. (Pl. ii, fig. 7).

There are three means by which the disease is distributed among the acarids : (*a*) By the germination of spores given off by the short conidiophores. In this way acarids immediately surrounding the diseased mites become infected. (*b*) By long fructifying hyphae, which develop at close intervals from three to six whorled conidiophores, each of which produces at its apex a single conidium. By this means the spores are dispersed and the disease is spread over comparatively large areas. (*c*) Finally, the vaguely branched, sterile hyphae enter the bodies of the mites with which they come in contact and produce the closely interwoven mass of acarids and hyphae already mentioned.

The effect of the action of the fungus on the mite's body becomes very noticeable as the disease progresses. At an early stage of infection a mite, while still alive, may have conidiophores and hyphae emerging from the skin, and also in most cases the sub-cutaneous hyphae can be distinguished. Its body, however, remains transparent, and the fat-bodies intact until they are reduced by the ramifying hyphae. Subsequent disintegration

of the internal tissues is probably brought about by enzymes excreted by the hyphae, for the mite loses its transparent appearance, becomes opaque, of granular consistency and dull yellow in colour. The internal tissues contract from the cuticle, and the acarid becomes much distorted in shape. This is partly due to loss of turgidity in the cells of the body which causes the skin to collapse, and partly to the rupture of the epidermis brought about by the exit of numerous conidiophores and hyphae. When the contents of the body have been absorbed by the fungus, the interior of the mite becomes a mass of interwoven hyphae, and the exterior is covered with dense masses of conidiophores and long sterile and fertile hyphae, which entirely obliterate its outline.

Chalcid grubs are also readily infected with the disease (Pl. i, fig. 6). The following results are recorded from inoculated specimens. On the second day after inoculation there was no visible sign of the fungus; on the fourth day, however, the grub was, apparently, lifeless, and tufts of long hyphae were seen to emerge from the discoloured portions of the body. By the sixth day the grub had become a mass of flocculent hyphae, and conidia were being abstricted from the short conidiophores proceeding from the discoloured parts. On the ninth day the whole grub was much discoloured and distorted in shape, and quantities of spores were being given off from short conidiophores and long fertile hyphae. By the fourteenth day the outline of the chalcid larvae was obscured by the ropes of interwoven fructifying hyphae covered with powdery masses of spores. At the end of the experiment the fungus had also infected and killed the mites covering the " big bud " leaves on which the chalcid grubs were placed. In the control experiments the chalcid larvae were alive and healthy. In order to ascertain the length of time required by the fungus to infect all the mites in the " big buds," cuttings were inoculated with the pure culture fungus and kept under (*a*) abnormal conditions, *i.e.*, in a damp chamber at room temperature, (*b*) under normal conditions, *i.e.*, out of doors. It was found that in the cuttings kept in the open the disease had inoculated the whole colony at the end of six weeks, while those kept in the laboratory under favourable conditions to the growth of the fungus, produced the same results in about half the time. By the conclusion of the experiment the mites, their eggs and the parasitic chalcid larvae were killed, while the embryonic leaves of the buds remained green and apparently uninjured. Attempts were made, with negative results, to inoculate insects and arachnids such as surface caterpillars, grubs of the garden weevil, the common

blowfly and garden spiders. Successful results, however, followed inoculation of Nut Mites (*Eriophyes avellanae*) and Birch Mites (*Eriophyes betulae*). The fungus was sent for identification to Mr. Massee, whose technical diagnosis of the species is as follows :—

Botrytis eriophyes, Mass.

Maculae parvae, niveae. Hyphae steriles repentes, septatae, 2-3 crass vage ramosae; fertiles erectae, ramis ramulisque subverticillatis. Ramuli tenues apice acutiusculi. Conidia prope apicem ramulorum inserta, cylindracea, hyalina, continua, erecta, 5-8 × 1.5-2μ.

Habit.—Parasitic on *Eriophyes ribis* (Nal.).

A minute fly belonging to the group *Chalcididae* is one of the most common and useful of the parasites which attack the mites, for it passes the greater part of the year in an active larval condition, during which time it lives between the leaves of

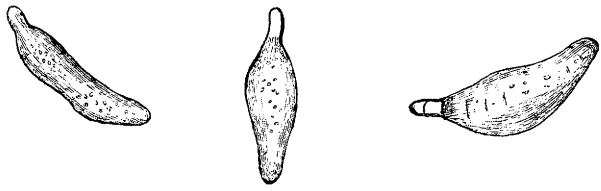


Fig. A.—Eggs of *Chalcid.* One is showing the segmentation of future larva.

the "big-bud" and depends solely on the mites for its means of subsistence. It is to be expected that the presence of this predaceous larva would help to diminish the number of mites in a "big bud." Numerically the mites must decrease by this constant parasitism, but their loss is so little felt among the thousands present that there is no apparent lessening of their numbers, nor is the "big bud" perceptibly smaller than those which contain no parasite. The habits of the larva too are such that comparatively little food is required by them. When it is considered that the larval stage is passed between the leaves of a bud, and that they are surrounded by more food than they can consume, it is not surprising to find them extremely lethargic, their reason for activity being removed. The number of mites therefore consumed by the grub is proportionately small, for only sufficient nourishment is taken to replace the waste of the body due to activity and growth.

The life-history of this parasite is simple. The perfect insects appear in May and live for the space of two or three weeks. The female fly selects for the purpose of depositing

the egg those buds which contain the necessary food for the future larva. The female fly is provided with a long ovipositor with which it pierces the " big bud " which is in process of development. The aperture thus made is of sufficient length to enable the egg to be placed near or in the centre of the young bud, where the newly-arrived mites congregate. The egg is distinctly stalked, transparent, colourless and has a dull shiny appearance (Fig. A). Usually one, sometimes two, are deposited in one bud among the mites. Through the transparent shell of the developing egg the process of segmentation can be followed, and after a period of three weeks the larva emerges as a legless worm-like grub, consisting of a head and thirteen body segments. The head is retractile, and the

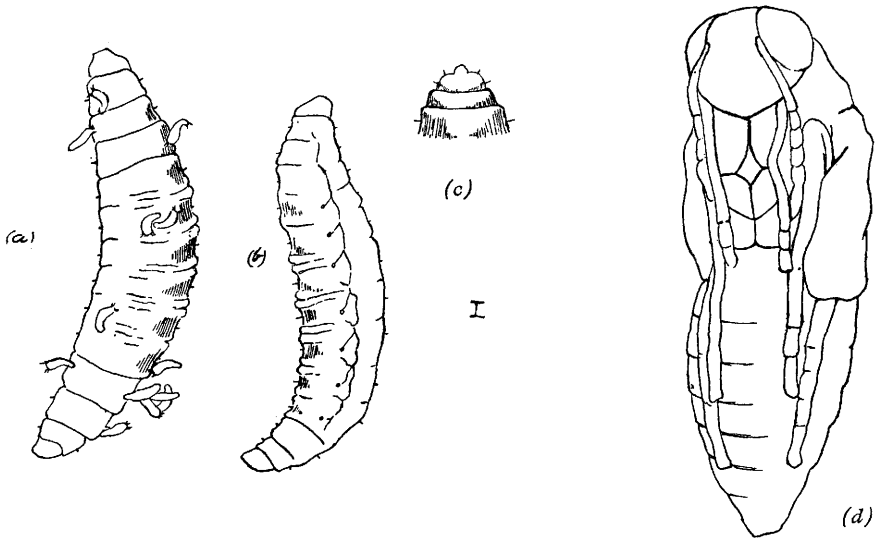


Fig. B.—(*a*) Larva of *Chalcid* over which the mites are crawling. (*b*) Larva of *Chalcid* showing trachael system. (*c*) Head of larva much enlarged. (*d*) Pupa of *Chalcid*.

organs of sight are undeveloped. The segments of the body are more or less well defined, and sparsely provided with setae, used by the grub as a means of locomotion. The larva has a transparent skin, through which the internal organs are seen, the colour of the body being greyish-white, except in the parts surrounding the alimentary canal, where a dull yellow tone predominates. When a grub is removed from its natural surroundings in a " big bud," it is covered with numbers of mites, which adhere to and crawl over its body (Fig. B *a*). The adhesion of the mites to the larva is apparently due to a sticky substance which is exuded from its skin. When occa-

sion demands, the grub can exhibit considerable powers of movement. In order to progress it must contract and arch the body, the posterior part is thus brought in contact with the anterior, the former is then

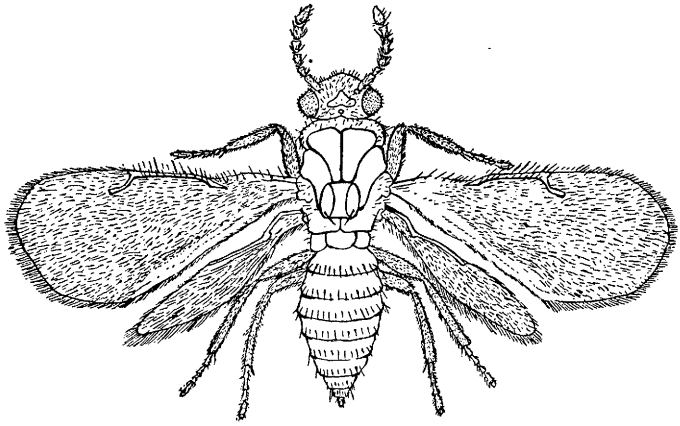
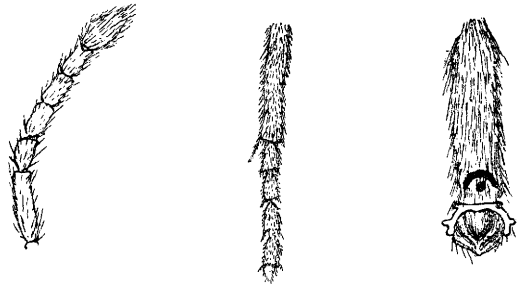


Fig. C.—Imago.

fixed and the latter moved forward, after which the process is repeated. The grub requires nine months to complete its growth, and by April the pupal stage is reached. The metamorphosis takes place within the bud which has now dried up, and from which the mites are in an active state of migration. Through the transparent pupal skin one sees that the fly is brown, that the wing-buds are prominent, and that the legs and antennae are not soldered to the body. In May the pupal skin is cast, and the perfect fly emerges



(a) *(b)* *(c)*

Fig. D.—(*a*) Antenna. (*b*) Tarsus. (*c*) Last Tarsus, showing pad.

to creep out from beneath the shrivelled leaves of the bud. The fly itself is a beautiful little insect, with large wings folded one across the other in the manner typical of the group. It possesses

considerable powers of flight, but usually prefers to move in a succession of short jumps, which is also a characteristic feature of the family *Chalcididae*. The whole body of the insect is more or less hairy and brown in colour. When alive the eyes are a brilliant red, and the division of the thorax, the scutellum, and occipital patch are outlined with yellow. After death the insect loses this vivid colouring and becomes almost uniformly brown. The venation of the wings is simple; a single definite nervure runs along the costal margin of the anterior wing, giving off at its termination a short vein thickened at the end. The posterior pair is much narrower and slightly veined along the costal margin. The wings are transparent, iridescent and densely covered with hairs, which give them the appearance of being fringed at the margins. The head is comparatively large, the eyes well developed, the antennae six jointed, setaceous, and the terminal joint clavate. The legs are long, slender, and covered with hairs, the tarsus is four jointed and terminates in a pad. Nine segments are visible in the abdomen, and in the female an ovipositor is present.

Mr. J. C. Crawford has, in the absence of Dr. Howard, of the Entomological Department, Washington, kindly identified the chalcid as a species of *Tetrastichus,* to which I give the name *Tetrastichus eriophyes*.

The expenses of this research were defrayed by a grant from the Research Fund of the University College, Reading.

EXPLANATION OF PLATES I AND II.

Illustrating Miss Adelaide M. Taylor's paper on the "Description and Life-histories of Two New Parasites of the Black Currant Mite, *Eriophyes ribis* (Nal.)."

PLATE I.

1.—Conidia germinating.

2.—Egg of Mite attacked by the fungus *Botrytis eriophyes*, Mass.

3.—Conidiophore of the fungus grown on Agar.

4.—Intertwining of conidiophores to form rope-like strands of fructifying hyphae.

5.—Mites attacked by the fungus.

6.—Chalcid grub attacked by the same.

PLATE II.

7.—Group of mites attacked by the fungus, much enlarged.

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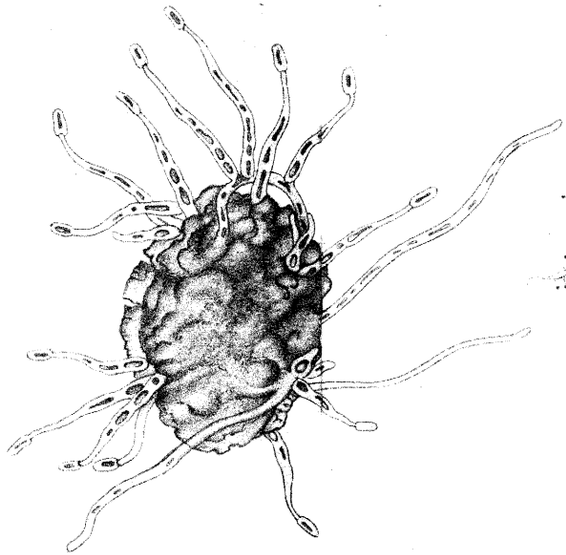

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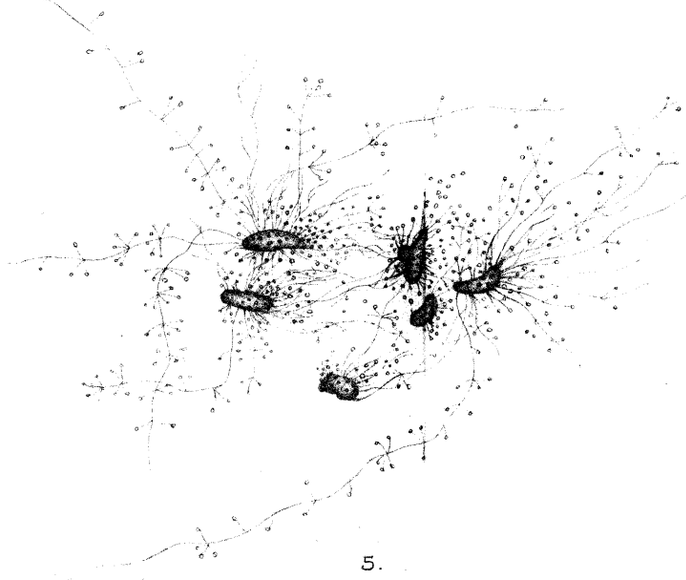

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4.

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BOTRYTIS ERIOPHYES, Mass.

Huth, Lith^r London.

7.

BOTRYTIS ERIOPHYES, Mass.

Huth. lith^y London.

DESCRIPTIONS OF TWO NEW SPECIES OF COLLEMBOLA.

By

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AND

JOHN W. SHOEBOTHAM, N.D.A.

With Plate III.

THE two species of Collembola here described are both of interest in that we believe one of them to have hitherto been referred to a well-known species, whilst the other we do not think has previously been recognised.

One, a species of *Sminthurus,* has been obtained by us in great abundance in several greenhouses and conservatories in the neighbourhood of Berkhamsted, in connection with our work on the Collembola and Thysanura of Hertfordshire; whilst the other, a species of *Papirius,* Lubb., was collected by Mr. R. G. Sims in Worcestershire, and is referred to in the account of the "Collembola and Thysanura of the Midland Plateau," written by one of us (3).

Sminthurus biflavopunctatus, n.sp.

Pl. III, figs. 1-7.

Body, dorsally dark brown, ventrally and legs yellowish-brown, with a pair of prominent yellow patches situated posteriorly and dorso-laterally on slightly raised prominences. Few scattered hairs. The whole of the cuticle is finely granulated (Pl. iii, fig. 4). Eye spot, with seven ocelli (Pl. iii, fig. 3). Antenna hairy, four-jointed, the distal segment being the largest, and terminating in a blunt end, on which is an antennal organ. Furcula somewhat broader than in *S. aureus,* with mucrones more spatulate, edges dentate. Feet, upper claw without a tooth, simple, under claw blade-like, no tenent hairs. Length, .57 millim.

Hab.—Berkhamsted.

This is an exceedingly active little species, running about rapidly, moving its antennae in short sudden quiverings. The usual habitat is around the underside of the lip of flower-pots.

Some of the specimens when found were submitted to Professor

Geo. H. Carpenter, who very kindly examined the same and expressed the view that they belonged to the var. *bimaculata,* of *Sminthurinus aureus,* Lubb., described by Dr. Axelson in 1902; from this view, however, we are forced, as a result of more minute examination, to differ.

On referring to Dr. Axelson's paper (1) we find that he described the var. *bimaculata* as a new variety of *Sminthurinus igniceps* (Reut.), but queried the species.

He states (*op. cit.* p. 110) " Grundfarbe schwarz, an den Seiten des Körpers ein grosser, gelber oder gelblichweisser, fast kreisrunder Fleck, welcher sich bei einigen Exmplaren nach unten erstreckt, mit der gelben Farbe am unteren Teile des Körpers zusammenfliessend. Das letzte Abdominalsegment und Furca sowie die Oberseite des Kopfes ausser den schwarzen Augenflecken gelb oder gelbweiss. Gelbbraunes Pigment findet sich an den Seiten des Kopfes. Ein kleiner schwarzer Fleck ist auf der Vorderseite des Kopfes oft wahezunehmen. Länge nur O, 4—O, 5 mm."

Our specimens differ from the above description in colour and markings, the large yellow spots never reaching underneath the body, whilst the general shape of the body is very distinct from that of *S. igniceps* (6, p. 22, T. i, figs. 2-2*b*).

According to Dr. Reuter's drawing (6, fig. 2), the terminal segment of the antennae is sharply pointed, whereas in our species it terminates bluntly, and has a minute bead-like antennal organ at the extreme end (Pl. iii, fig. 5 *a. o*). The foot of *S. igniceps* is also very distinct from the form obtaining in this species (cf. Reuter T. i, fig. 2*b*).

Dr. Axelson points out that it is difficult to determine whether the var. *bimaculata* represents a characteristic form or only a variety. The *S. igniceps* of Reuter he observes is, in Finland, a typical hot-house species, whereas this variety is found by the side of ditches or streams, and is noticeably smaller.

After satisfying ourselves that the form we had was distinct from *S. igniceps* (Reuter), we next compared it with examples of *S. aureus.* Lubbock's figures (5, pl. 7) agrees with examples of that species we have in our collection. The general outline and contour of the body, as also the size and minor details in the form of the ocelli (see Guthrie, 4, pl. xviii, fig. 8), are all quite distinct from the specimens here described.

Curious to say in the localities where these specimens were found we have been unable to find any that could be referred to either

Sminthurus aureus, Lubb., or *Sminthurinus igniceps* (Reuter), although the former species is by no means uncommon in this neighbourhood.

Papirius carpenteri, n.sp.

Pl III, figs. 8-12.

Body globular, with a few scattered hairs. Colour dorsally mottled, with a deep blackish-brown and yellow. Anal segment spotted with yellow. The antenna consists of four segments, and is characterised by its roughened knobbed form, and the division of the two distal segments into a number of separate joints. The first segment is the shortest, a mere stump-like body; the second is long and marked with a number of irregular knobs; the third, the longest of the four, consist of an unjointed proximal portion and a five-jointed distal portion, the distal division terminating in a broad, knobbed, club-like head, with four prominent blunt spikes, which project beyond the segment; the fourth segment consists of five divisions; the first being the largest, and occupying more than half of the segment. All the divisions are characterised by their roughened surface and a series of somewhat spirally arranged bosses or studs (Pl. iii, fig. 9).

The whole of the segments are covered with scattered hairs, but these are not arranged in whorls, as in some species of the Genus. Eye spot with eight ocelli, six large ones and two smaller ones (Pl. iii, fig. 11). The feet are very characteristic; each terminates in two claws, the upper of which is stout and curved, terminating bluntly with a small finger-like protuberance on the inner side (*f*). Near to its proximal end, and on the dorsal side, is a well-marked tooth-like spine (*sp.*). The lower claw is flat, blade-like, and somewhat triangular in shape, it is produced in its inner side into a short spine (*s. sp.*), and the same condition obtains at its extreme distal end. Just before this latter is a long hair-like spine on the inner side (*h. sp.*). The blade is raised in the median line (*m.l.*), this raised portion arising from a prominent boss or ridge at the proximal end (*b*). The claws articulate upon a trapezoid-like segment (*t. sg.*). There is no tooth on the inner margin of the upper claw, as is present in *P. ornatus*. The mucro (Pl. iii, fig. 12) is somewhat elongated, and has the edges closely dentated, the teeth being blunt. Length, 1.2 millim.

Hab.—Abberley, near Stourport (R. G. Sims).

Under pieces of decaying branches and pieces of wood close to the side of a stream.

We have pleasure in associating with this species the name of

Professor Geo. H. Carpenter, whose investigations have added so largely to our knowledge of this interesting Order of insects.

P. carpenteri finds its nearest relationship with *P. ornatus* (Nic.), Lubb., but differs from that species as described and figured by Lubbock (5), and also Carpenter and Evans (2), in the form of the antennae, the mucrones, the ocelli, and the form of the feet.

We have examined a large number of specimens of *P. ornatus,* all of which agree pretty closely with Lubbock's figures. In no case have we found the terminal segment of the antenna jointed, nor do the other segments agree at all with the condition which obtains in *P. carpenteri.*

The possibility of this species being referable to Bourlet's genus *Dicyrtoma* has occurred to us, but being unacquainted with any of the species of that genus and unable to refer to any of the figures, we are not able to offer any opinion.

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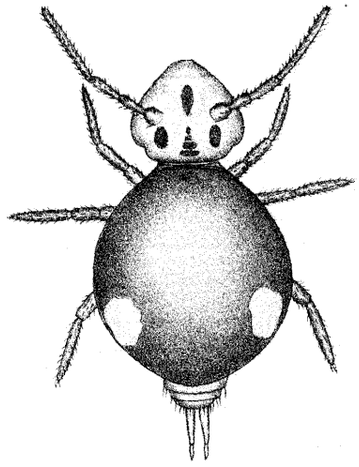

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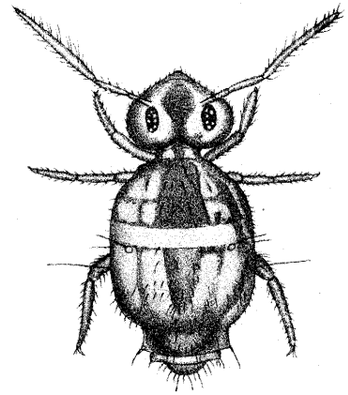

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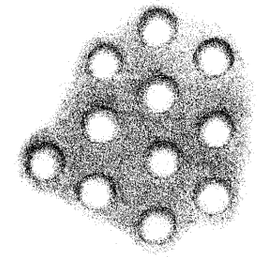

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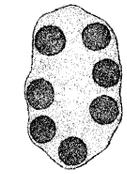

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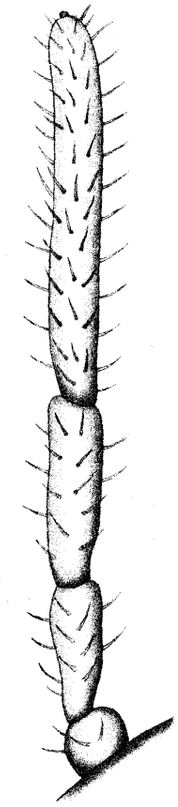

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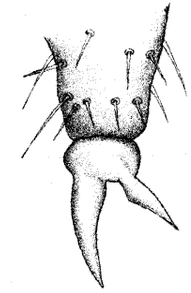

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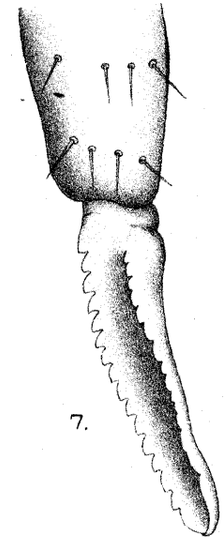

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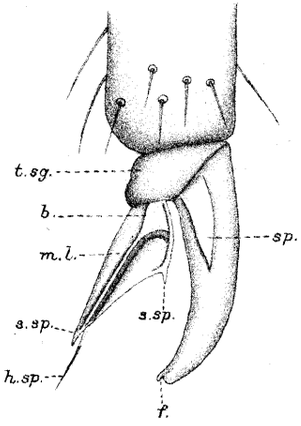

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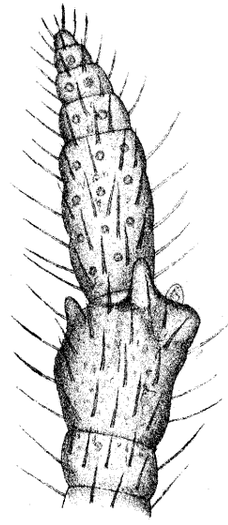

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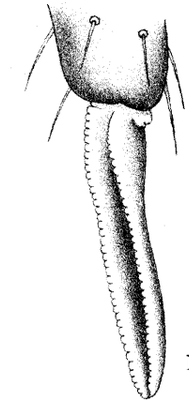

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J.W.S. del. ad nat.

NEW COLLEMBOLA.

EXPLANATION OF PLATE III.

Illustrating Messrs. Collinge and Shoebotham's paper on "Two New Species of Collembola."

Fig. 1.—*Sminthurus biflavopunctatus*, n.sp.

Fig. 2.—*Sminthurus aureus*, Lubb. Copied from Lubbock's Monograph.

Fig. 3.—*Sminthurus biflavopunctatus*, n.sp. Left Eye spot.

Fig. 4.— ,, ,, Portion of integument.

Fig. 5.— ,, ,, Antenna.

Fig. 6.— ,, ,, Foot of the 3rd leg.

Fig. 7.— ,, ,, Mucro.

Fig. 8.—*Papirius carpenteri*, n.sp. Lateral view of the antenna.

Fig. 9.— ,, ,, Terminal portion of the same seen from below.

Fig. 10.— ,, ,, Foot of the 3rd leg.

Fig. 11.— ,, ,, Left Eye spot.

Fig. 12.— ,, ,, Mucro.

Reference Letters.

a.o.—Antennal organ.

b.—Boss.

f.—Finger-like process.

h.sp.—Hair-like spine.

m.l.—Median Line.

s.p.—Spine.

s.sp.—Small Spine.

t.sg.—Trapezoid-like segment.

All the figures are drawn with the aid of a Leitz Drawing Eyepiece.

OBSERVATIONS ON THE LIFE-HISTORY AND HABITS OF *THEREVA NOBILITATA*, FABR., AND OTHER SPECIES.

By

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

Berkhamsted.

With Plate IV.

Contents.

1.—Introduction.

The Genus *Thereva* was erected by Latreille in 1796 for a number of medium-sized flies, occurring, in this country, mostly in small plantations, thickets, orchards, and on the outskirts of woods. Generally speaking, they prefer dry, sandy soils.

Verrall[1] catalogues six British species, one of which is doubtful, and in his Monograph[2] enumerates eight species.

Sharp[3] states that "we have about ten species in Britain, and there are some two hundred known from all the world. But little is known as to the metamorphoses."

All the species have a more or less economic value, and during the past few years a large number of the larvae and imagines have passed through my hands.

Beyond the actual descriptions of the imagines there is little literature bearing upon the larvae, pupae, and life-history of the different species.

Lundbeck[4] gives perhaps the longest notice of the larvae and pupae and their habitat.

Washburn,[5] in his account of the Diptera of Minnesota, states: "The family is a small one, predaceous in the adult and larval forms

[1] List of British Diptera, 2nd ed. Cambridge: 1901.

[2] British Flies. London: 1909, vol. v.

[3] Insects. Cambridge Nat. Hist, pt. ii, p. 484.

[4] Diptera Danica. Copenhagen: 1908. Pt. ii.

[5] Tenth Annual Report State Entom. of Minn., 1905.

upon insects in the young stage, probably feeding upon vegetable matter also."

Where not otherwise stated, the following remarks apply to *T. nobilitata,* Fabr.

2.—The External Form and Habits of the Larva.

The larva (Pl. iv, fig. 1) is elongate, vermiform, cylindrical, and pointed at each end; in colour a semi-transparent greenish-white, with more opaque white markings dorsally. There are apparently twenty segments excluding the head, although only thirteen true ones. The head (Pl. iv, fig. 2) is small, chitinised, and of a deep brown, and carries short antennal papillae; eyes absent. There are a pair of latero-ventral bristles on each of the three thoracic segments. Each of the first six abdominal segments appear as two segments, particularly so when viewed from the dorsal side, and the first seven have on their ventral side a series of punctiform muscular impressions.

On the eighth abdominal segment there are a pair of posterior spiracles situated on the antero-lateral portion of the segment, and a pair on the prothorax; Dr. Sharp[1] figures these on the mesothorax, cf. p. 38, fig. 65. It is only fair to mention that the specimen figured by Dr. Sharp was a very young one, taken from the roots of a currant bush at Sutton Coldfield. The last segment is the only one that exhibits any marked modification. Firstly, it is perfectly divided into an apical and a posterior portion, the latter terminating in two small styliform bodies (Pl. iv, fig. 3). There are six bristles, arranged dorso-laterally, laterally, and ventro-laterally. The anal aperture opens on the ventral surface between and slightly anterior to the styliform bodies.

The larvae prefer compact but sandy soils, in which they move about very actively. In wet and sticky soil they make use of the burrows formed by earthworms, and it was noticeable that, under these conditions, they invariably formed a small chamber off one of the burrows. In one case one was noticed feeding upon a small earthworm. Out of the soil they move by a series of jerks in a somewhat serpentine fashion. When laid on the surface of the soil they very soon made their way beneath the surface, usually remaining four to six inches below; in wet, or sticky soil, they were found much deeper, travelling, in all probability, by means of the burrows of earthworms.

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[1] Verrall, British Flies, 1909, vol. v.

The first example I received was collected on November 23rd, 1906, by Mr. R. Welch, of Sutton Coldfield, which he found at the roots of currant trees.

On December 3rd, 1906, he forwarded five more examples all of which were placed in the jar containing the specimen previously sent. Five days later only one specimen was found, it being concluded that the first specimen had eaten the others. Since then many more examples have been received from various nursery gardeners near to Birmingham and elsewhere.

Mr. Welch states that he has found them in the districts of Wylde Green, Sutton, and Four Oaks, and has usually found solitary ones, and in sandy or light soil. Sometimes at the roots of pinks and violas.

Mr. Welch speaks of the specimens forwarded as white ones, but earlier in the season he noticed specimens marked with black bands, probably another species.

The imago appeared on April 3rd, 1907. Since then many other examples have been reared from the larvae.

The larva mentioned above was kept alive until March 4th, 1907, when it pupated; it was fed on the larvae of *Ceuthorhynchus sulcicollis,* Gyll., one of which was sufficient for three or four days' food supply. Some tiny larvae of a small dipterous fly were also fed to some specimens, but they much preferred the less active weevil larvae. Others were fed on very small earthworms. Sharp mentions that the larvae of some species have been recorded as feeding upon the dead pupae or larvae of Lepidoptera.

Beling[1] records finding the larvae and pupae of *T. oculata,* in cow dung, and Westwood[2] mentions having found the larva of an undetermined species which attacked the pupae of *Alencis pictaria* and *Sphinx ligustri*; other observers have described them as being bred from Lepidopterous larvae.

I can find no mention of the eggs, what they are like, or when and where deposited.

3.—The Pupa.

The Pupa (Pl. iv, fig. 4) is shorter and considerably broader than the larva. At first it is a light yellow in colour, but with the thickening of the cuticle it soon changes to a yellowish-brown or light chocolate-brown. It is not enclosed in the larval skin, but free,

[1] Arch. für Naturgesch., 1875.

[2] Proc Entom. Soc. Lond., 1859, p 59.

In all cases the pupae were found on the *surface of the soil* or only partially covered by it.

The antennal sheaths lie on the front side of the head, directed to each side; at the base of the wing sheath is a turbercle, which terminates as a fine spine. On each side of the thorax is a thin, blunt spine. The abdominal segments are partially girdled by bristles with intervening short spines from the hinder margin; dorsally there is a band extending from side to side, but that on the ventral side does not extend to the lateral edge of the segment; laterally there is a tuft of better developed spines and antero-laterally a slight protuberance which also carries the spiracle. The first segment has only a single bristle laterally. There are a pair of prothoracic and seven pairs of abdominal spiracles; the last segment terminates in a long, dark brown, attenuated bifid spine.

Length, 13 millim.

4.—The Imago and its Habits.

The imago is a medium-sized fly, and locally common on the outskirts of woods, in small plantations, thickets, orchards, etc. Generally speaking, *T. nobilitata* prefers dry, sandy soils.

Although generally considered as predaceous, I have not been able to find any evidence for such, although the fact that the flies are usually found sitting on leaves as if watching for prey would seem to lend credence to such a view. In confinement the flies soon died, most at the end of the fourth day; in one case, however, two examples were kept alive twelve days. Although kept in a large glass case they were seldom seen to fly properly, their movements consisting of a short hop-like flight of a few inches distance, and then walking very slowly. Specimens watched for forty-five minutes made practically no movement whatever, and when examined some five hours later were found exactly in the same position.

5.—Systematic.

The species I have bred are *T. nobilitata, T. plebeia, T. funebris,* and *T. annulata.*

Some difference of opinion exists as to the specific distinctness of *T. plebeia.* Mr. Verrall[1] thinks it possible that an unrecognised species exists between *T. plebeia* and *T. bipunctata,* a view with which I concur; at the same time I think there is a distinct variety of *T. nobilitata* which approaches very closely some male forms of *T. plebeia.*

[1] British Flies, vol. v.

I have frequently met with two species in copulation, also *T. annulata* and *T. plebeia*. Mr. Verrall records similar occurrences.

Lundbeck ([1], p. 133) states that he is unacquainted with any case of parasitic Hymenoptera on Therevids, and in the scores of examples I have bred out no parasitic insect has been observed.

The larvae also seem to be particularly free from the attacks of other ground larvae.

EXPLANATION OF PLATE IV.

Illustrating Mr. Collinge's paper on "Observations on the Life-History and Habits of *Thereva nobilitata*, Fabr., and other species."

Fig. 1.—Larva. × 2.

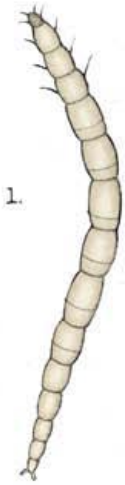
Fig. 2.—Head and thoracic segments of the same enlarged.

Fig. 3.—Last abdominal segment, showing styliform bodies and bristles.

Fig. 4.—Pupa from the ventral side. × 8.

Fig. 4a.—One of the lateral bristles enlarged.

[1] *Tom. cit.*



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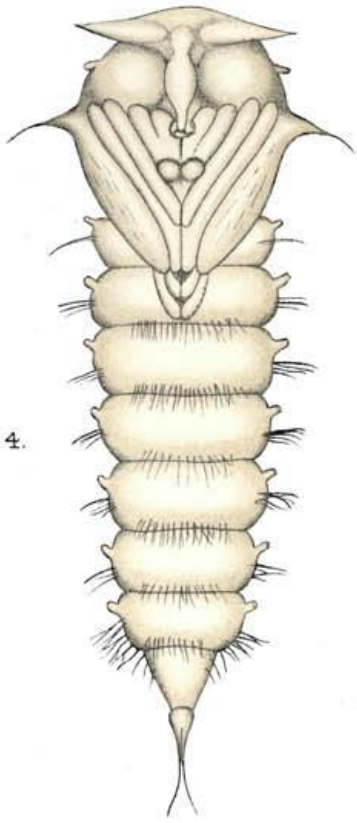

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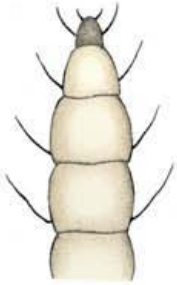

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3.

4 a.

W.E.C. del. ad nat. Huth, Lith^r London.

THEREVA NOBILITATA, Fabr.

NOTE.

Note re Rat Parasites.

Since publishing my article on the Parasites of Rats, Mr. William Evans, of Morningside Park, Edinburgh, has drawn my attention to the fact that he has collected both male and female specimens of *Typhlopsylla agyrtes,* Heller, from off *Mus decumanus,* taken at Drem, Haddingtonshire. This is recorded in his Paper on Siphonaptera in the "Annals of Scottish Natural History," 1905, p. 162. I regret I overlooked this reference when preparing my paper on Rats and their Parasites.

A. E. SHIPLEY.

REVIEWS.

Board of Agriculture and Fisheries Leaflets. Revised series. Nos. 1-12. London: The Board of Agriculture and Fisheries, 1908.

We have before us a volume containing the first hundred of the Leaflets of the Board of Agriculture, also 12 Sectional Volumes containing Leaflets 1-200. Indices have been added, and various Leaflets have revised.

In this sectional form and indexed, the various volumes must prove considerably more useful and easier of reference.

In looking through very many of the Leaflets one regrets that the Board have not submitted them to specialists, and also that it is not provided with better financial assistance, whereby these could have been produced in a style at least equal to that of the Farmer's Bulletins of the U.S. Department of Agriculture.

W. E. C.

Deperet, Charles.—The Transformations of the Animal World. Pp. xvi + 360. London, Kegan Paul, Trench, Trübner and Co., Ltd., 1909. Price 5s.

At a time when many students are approaching the study of animal evolution for the first time, the appearance of an English translation of this well-known work is most opportune.

In chronological order the author sets forth the historical development of ideas, the work of the earlier investigators such as Cuvier,

Buffon, Goethe, and Oken, and that of the later workers such as Lamarck, Darwin, and Haeckel.

Turning next to the evolutionary ideas in palaeontology he traces the advances made by Neumayr, Cope, Gaudry, and von Zittel, and discusses the laws of palaeontology; the causes of the extinction of species; the mechanism of the production of new forms; and the action of migrations.

The book is full of interest to both palaeontologist and geologist, but the absence of any references to literature, and the revision of the translation by some competent biologist, are two very serious drawbacks to an otherwise technical, but very interesting work.

W. E. C.

Gaskell, W. H.—The Origin of Vertebrates. Pp. ix + 537, 168 figs. London: Longmans, Green and Co., 1908. Price 21s. net.

In his introduction Dr. Gaskell points out that during the twenty years in which he has published the papers from which the present work is compiled, his theory of the origin of vertebrates has been ignored by the morphological world as a whole rather than criticized, and he has been led to put his conclusions into book-form with the hope that those who differ from him will come forward and show him where he is wrong, and why his theory is untenable.

Personally we very much doubt whether this battle royal will ever take place, for so many theories as to the origin of vertebrates have been put forward, all equally tenable (and equally futile) that most zoologists are tired of these one-sided, narrow-grooved views, and are content to leave the matter alone.

Provided we grant certain premises, Dr. Gaskell's theory is equally sound with any that have gone before, but, it is just these premises which are the stumbling block.

Briefly the author endeavours to prove that vertebrates are derived directly from arthropods, that the arthropodean alimentary canal is represented by the ventricles of the brain and the central canal of the spinal cord, the pituitary body and embryonic pharynx represent the mouth of the arthropod, and the neurenteric canal the primitive anus. The different parts of the central nervous system of the arthropod are shown to have given rise to those of the vertebrate brain, and so on. Ammocoetes, the larval lamprey replaces our much tried friend Amphioxus as the nearest living representative of the early fish-like vertebrates, and the chain of succession is gradually built up.

The book is indeed a brilliant piece of patient deductive work, and will be read with interest by those who take an interest in such theories.

W. E. C.

Lankester, Ray.—A Treatise on Zoology. Part 1. Introduction and Protozoa. First fascicle by S. J. Hickson, J. J. Lister, F. W. Gamble, A. Willey, H. M. Woodcock, the late W. F. R. Weldon, and E. Ray Lankester. Pp. xiv + 296, 151 figs. London: Adam and Charles Black, 1909. Price 15s. net.

In the few lines in which Sir E. Ray Lankester prefaces this volume, he points out that the two fascicles of the first part of this treatise give a more complete account of the Protozoa than is to be found in any similar work hitherto published, and he might very justly have added, written and edited in a style seldom if ever surpassed.

The present fascicle opens with an Introduction by the Editor, in which he briefly and lucidly discusses (*a*) the dividing-line between plants and animals, (*b*) the separation of the Grade Protozoa from the Grade Metazoa, and (*c*) the separation of the Classes of Protozoa into Grades of lower and higher structure.

Of the different Sections we cannot pretend to criticise. All have been placed in the hands of acknowledged authorities, and are admirable in detail and as concise as is consistent with lucidity. The two volumes must prove invaluable to all students of the Protozoa, replete as they are with the fullest information and full bibliographic references, and at the same time indispensable to all zoologists.

W. E. C.

Lundbeck, William.—Diptera Danica. Genera and Species of Flies hitherto found in Denmark. Pt. 1. Pp. 166 and 47 figs. and 1 portr. Pt. II., pp. 160 and 48 figs. Copenhagen: G. E. C. Gad. London: William Wesley and Son, 1907, 1908.

Amongst the few really important monographs of the Diptera, Professor Lundbeck's "Diptera Danica" will take a prominent position, and the fact that it is written in English will appeal to a large circle of dipterologists.

The author has followed Brauer in the classification, and commences with the Orthorrhapha brachycera.

Part I. treats of the *Stratiomyiidae, Xylophagidae, Coenomyiidae, Tabanidae, Leptididae,* and *Acroceridae;* and Part II. with the *Asilidae, Bombyliidae, Therevidae,* and *Scenopinidae.*

After briefly reviewing the earlier writings on Danish Diptera, a short account is given of the terminology used in the work, followed by some notes on the nature of the localities.

Turning to the systematic portion we find the diagnoses clear and detailed, at once indicating the author to be thoroughly conversant with his subject, and whilst we welcome the admirable word-portraits of the different genera and species, we are doubly grateful for the excellent accounts that are given of the egg, larva, and pupa; their place of deposition, habitat, habits, etc.

Indeed, if the author had not done more than present us with the careful descriptions of the larvae, they would be sufficient in themselves to constitute a most useful work of more than ordinary value to the student of the Diptera. In few Orders of Insects are the larvae of more interest and importance than in this one, and it is the exception to find more than a passing reference to them in the chief monographs.

We look forward to the early appearance of future parts of this work, which, when complete, must take a high rank amongst dipterological literature, and one that no student of the Order can afford to be without.

The two parts before us are well printed, and the illustrations, although few, are well reproduced.

W. E. C.

Newstead, R.—The Food of Some British Birds. Suppl. to Journ. Board Agric., 1908, vol. xv, pp. viii + 87. Price 4d.

For many years a controversy has raged as to the economic value of certain British wild birds, but the difficulty one has always had to face has been the absence of any careful and systematic details giving the crop and stomach contents of the species under discussion. In the absence of such it has been impossible to come to any satisfactory or practical conclusions.

Mr. Newstead's list enumerates no less than 871 post-mortem examinations of the stomach contents and the "pellets" or "castings" of 128 British birds. Of many of these there has never been any doubt as to their beneficial influence, and whilst we heartily welcome the author's memoir as an excellent piece of work, its value is considerably lessened by the fact that of the really doubtful species only a few post-mortems have been made: thus of the Blackbird 12, Greenfinch 11, Chaffinch 27, Bullfinch 26, Magpie 8, Jackdaw 11, Rook 14, Starling 16.

Any conclusions based on so small a number of post-mortems can only be of partial value, for the information desired is the nature of the food in different localities, based on stomach-content examinations throughout the whole of the year. The recently appointed Ornithological Committee of the British Association will no doubt ultimately provide this much desired information. In the meantime, Mr. Newstead's interesting memoir affords much material for thoughtful reflection and study.

W. E. C.

Nuttall, G. H. F., Warburton, C., aided by Cooper, W. F., and Robinson, L. E.—Ticks: a Monograph of the Ixodoidea. Pt. I. *Argasidae*. Pp. x + 104 + 35, 3 plts. and 114 figs. Cambridge: University Press, 1908. Price 5s. net.

The authors' prefatory note states, "the discovery of the economic importance of ticks as carriers of disease to man and domesticated animals

has led to a vast increase of our knowledge of this group. No existing work in any language attempts to deal with the subject in a comprehensive manner . . . there is therefore urgent need for a work of the nature here attempted."

In the part before us an excellent account is given of the *Argasidae,* and much labour seems to have been expended upon the classification and literature. We had hoped that a full account of the anatomy would have prefaced each Family and Genus, but the authors promise an adequate introduction at a later date.

It is not too much to say that no one interested in the study of *Ixodoidae* can afford to be without this work, which is well printed and illustrated.

Whilst fully cognisant of all the good features to which we would give the fullest praise, we cannot overlook the fact that there are, in our opinion, some unnecessary weak ones.

One of the most striking is the waste of space under the headings synonymy, iconography, and literature. The laboured manner in which they have been compiled and the often needless comments interspersed, might well have been dispensed with.

Hitherto in most, if not all, systematic works of this character, it has been possible to refer to the source of the original description and synonymy of a species with the least possible trouble. In the work before us the reference is omitted, and one has to turn to the Bibliography of about 300 titles to hunt for each one required. Such a method is known as the Havard system, and we hope it will be a long time before we meet with it again.

Another point to which we take objection is the manner in which the authors use the figures of others, acknowledging them as follows: (Nn. 1896, fig. 27), surely it is as little as the borrowers can do to state "After Neumann," or "Neumann, 1896, fig. 27," particularly so after the note on p. vi, in which their own respective work is so vigilantly guarded.

W. E. C.

Stebbing, E. P.—A Manual of Elementary Forest Zoology for India. Pp. xxiii + 230 + xxxiv, 422 figs. Calcutta: Superintendent Government Printing, 1908. Price 15s.

Mr. Stebbing may be congratulated on having realised and produced the nearest approach to a text-book on Economic Zoology we have yet seen, although the author lays no claim to its being more than an elementary manual of forest zoology.

The work covers the whole animal classification, but throughout prominence is given to the economic side.

The most important section is undoubtedly that treating of the Insecta and the numerous careful and detailed life-histories, profusely illustrated,

bear testimony to the valuable work the author has done and is doing. The economic importance of entomology to Indian forestry is fully realized, and Mr. Stebbing seems to have lost no opportunity of impressing the importance of the subject upon his readers.

Whilst according unqualified praise to the section devoted to the Insecta, we are equally pleased with the manner in which the fishes and birds have been treated, particularly the latter.

The book will be found of great value not only to Indian foresters, but to all who desire a fuller knowledge of Economic Zoology.

We heartily congratulate the author on his work, but much regret the style in which it has been produced. The wretched poor paper has marred the text, and the absence of proper plate paper has, with a few exceptions (*e.g.*, figs. 193, 194, 259, 261, 313, and 314) spoilt the illustrations. With better paper most of the figures might, with advantage, have been included in the text.

W. E. C.

Verrall, G. H.—British Flies. Vol. v, pp. iii + 780 + 34, 406 figs. London: Gurney and Jackson. Price £1 11s. 6d.

We are pleased to welcome a second volume of Mr. Verrall's great work, and to learn that two more are in active preparation.

The present volume opens with a general account of the Diptera Orthorrhapha, including an admirable description of the metamorphoses of the Diptera Brachycera and of the *Platypezidae, Pipunculidae,* and *Syrphidae,* by Dr. Sharp.

The purely systematic part deals with the *Stratiomyidae, Acanthomeridae, Leptidae, Tabanidae, Nemestrinidae, Cyrtidae, Bombylidae, Therevidae, Scenopinidae, Mydaidae, Apioceridae,* and *Asilidae.*

The reputed British species of the different families are next treated of, and the volume concludes with a systematic list of the families of Palaearctic Diptera Brachycera included in the present volume.

The figures of Mr. J. E. Collin are wonderfully clear, and merit all praise.

Dipterologists throughout the world are under a deep obligation to the author for what promises to be a remarkable and invaluable work.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Forbes, S. A.—Aspects of Progress in Economic Entomology. Journ. Econ. Entom., 1909, vol. ii, pp. 25-35.

Froggatt, W. W.—Notes on the Value of Introduced Parasites or Beneficial Insects. W.I. Bulletin, 1908, vol. ix, pp. 262-264.

Hopkins, A. D.—Work of the Bureau of Entomology against Forest Insects. Journ. Econ. Entom., 1908, vol. i, pp. 343-348.

Pierce, W. D.—A List of Parasites known to attack American Rhynchophora. Journ. Econ. Entom., 1908, vol. i, pp. 380-396.

II.—Anatomy, Physiology, and Development.

Barber, C. A.—Studies in Root Parasitism. IV.—The Haustorium of *Cansjera rheedii*. Mem. Dept. Agric. India, Bot. Ser., 1908, vol. ii, no. 5, pp. 1-37, plts. i-xi.

Guilbeau, B. H.—The Origin and Formation of the Froth in Spittle-Insects. Amer. Nat., 1908, vol. 42, pp. 783-798, 8 figs.

Pierce, F. N.—The Genitalia of the Group Noctuidae of the Lepidoptera of the British Islands. Pp. xii + 88, 32 plts. Liverpool: A. W. Duncan, 1909. Price 7s. 6d.

It is refreshing to find a lepidopterist in the British Isles who, for upwards of twenty years, has been interested in the wonders of the structure of these insects, rather than in collecting or the dry investigation of nomenclature. If for no other reason we extend a hearty welcome to a book that at once commands attention by reason of its detail and patient and minute accuracy.

The author enumerates upwards of three hundred species contained in one hundred and seven genera.

The descriptions throughout are clear, though brief, and the drawings are excellent. Like most lepidopterists, Mr. Pierce is content to quote the names of species without the genera, which is to be regretted, as also the absence of plate references, and authorities for the different genera and species.

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If one were to suggest to the majority of British fruit growers the advisability of fumigating the trees in their comparatively tiny orchards as compared with those of which Dr. Morrill writes, what derision one would call forth.

After a careful perusal of this bulletin we are more than ever convinced that the British fruit grower has yet very largely to learn how to treat his orchard.

When one realizes that the American fruit grower is willing to spray three and four times at a cost of 1s. 2d. per tree, or fumigate at the same outlay, it is not to wondered at that his fruit is so much better than ours, where cheapness and inefficiency seem to be the chief considerations.

Dr. Morrill's work will well repay careful study, and will come as a revelation to many growers who fancy they have nothing further to learn respecting orchard and plant pests and their treatment, but whose orchards and crops would disgrace an amateur.

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THE
JOURNAL OF ECONOMIC BIOLOGY.

A CONTRIBUTION TO OUR KNOWLEDGE OF THE BRITISH THYSANOPTERA *(TEREBRANTIA)*, WITH NOTES ON INJURIOUS SPECIES.

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ALTHOUGH the insects of the Order Thysanoptera, or, at any rate, those belonging to the sub-order *Terebrantia*, are admittedly species of economic importance, it is only comparatively recently that they have received any marked attention by entomologists, and since the publication of Haliday's important papers on the British species in 1836 and 1852, the Thysanoptera have been systematically neglected by British naturalists, probably on account of the minute size and somewhat difficult characters of differentiation of the majority of species, coupled with the fact that they must be collected in spirit, to which mode of collecting so many of our entomologists seem to have a very distinct aversion.

In January, 1908, I published some notes on certain British species, recording as new to our fauna *Megathrips lativentris* (Heeger); *Trichothrips caespitis,* Uzel; *Euthrips robustus* (Uzel); *Oxythrips ajugae,* Uzel; *O. parviceps,* Uzel; *Uzeliella lubbocki,* Bagnall; *Heliothrips femoralis,* Reuter; *Parthenothrips dracaenae* (Heeger); *Thrips communis,* Uzel; and *T. major,* Uzel; and in three short papers published this year, *Anaphothrips orchidaceus,* Bagnall; *Megathrips nobilis,* Bagnall; *Cryptothrips dentipes* (Reuter); *Trichothrips copiosus,* Uzel; and *T. semicaecus,* Uzel, are recorded as British. It should be noted, however, that *Thrips communis,* Uzel, is a synonym of *T. tabaci,* Lindeman, described in 1888,[1] and is the species recorded as the "Thrips on onion plants," by Mr. Shipley, F.R.S., in 1887[2]. In the present preliminary paper

[1] Die Schadlichsten Insekten des Tabak in Bessarabien, 1888, p. 15, 61-75.
[2] Bulletin 10, Miscellaneous Information Royal Gardens, 1887, p. 18.

further records are given for *Parthenothrips dracaenae, Heliothrips femoralis, Anaphothrips orchidaceus* and *Thrips tabaci,* whilst *Chirothrips similis,* sp. nov., *Euthrips orchidii,* Moulton, *E. longipennis,* Bagnall, *E. inconsequens* (Uzel), *E. pyri,* Daniel, *Leucothrips nigripennis,* Reuter, *Heliothrips haemorrhoidalis* var *abdominalis,* Reuter, *Thrips salicaria,* Uzel, and *T. juniperina* (L.), are for the first time recorded from the British Isles, the male of *E. pyri* being new to science. Some of these additions are of considerable interest, most notably the records of *E. pyri* and *T. juniperina.* The former was previously only known from California, U.S.A., and is regarded as one of the most injurious insects, whilst the species I refer to *Thrips juniperina,* Linnaeus, though recognised between the years 1744 and 1806, has since been lost to science. Most of these species will be fully described and figured in a future paper, which I hope to prepare on the British Thysanoptera, and, so that this essay on the British species may be more complete, I shall be very pleased to receive and acknowledge the communication of collections from all parts of the British Isles, and to give hints as to the best methods of collecting, etc., to those who wish to take up their collection and study.

I would take this opportunity of thanking Mr. Collinge for the material he has so kindly submitted to me.

Order THYSANOPTERA.

Sub-Order TEREBRANTIA.

Family **Thripidae.**

Chirothrips similis, sp. nov.

This species very closely resembles the common *C. manicatus,* and differs chiefly by its much larger size, the broader basal antennal joint, the longer and more linear abdomen, and the arrangement of spines on the fore-wing. It is a large species, my examples measuring 1.5-1.6 mm. in length.

Two females swept from grass, Gibside, August, 1908. I know the exact spot where these specimens were captured and hope to take both sexes this summer, and to describe and figure the species in detail in my proposed essay on the British Thysanoptera.

The following table of the known species of the genus *Chirothrips* may be useful :—

1. Antennae with the second joint simple—
hamatus, Trybom (*dudae,* Uzel).

II. Antennae, with the second joint ending in a blunt prominence at the outer angle.

1. Without spines at each hind-angle of prothorax— *obesus,* Hinds, *crassus,* Hinds.

2. With spines at each hind-angle of prothorax :—

i. Female. Size smaller (0.8-1.1 mm.); abdomen ovate, not twice as long as broad; hind-vein of fore-wing with four spines, two near fork and two towards tip—

manicatus, Haliday.

ii. Female. Size larger (1.5-1.6 mm.) ; abdomen elongate-ovate, three times as long as broad; hind-vein of fore-wing with six more or less regularly placed spines—

similis, sp. nov.

Limothrips cerealium, Hal.

(L. avenae, Hinds.).

I have taken two examples of the female from the flower of the bittersweet (*Solanum dulcamara*) Swalwell, July, 1907, and two females from the sap of a felled pine tree at Winlaton on the 14th of September, 1907, but have never found the species in numbers excepting on cereal crops. It is therefore very interesting to note that Mr. Collinge has found the female of *L. cerealium* in numbers in witches broom, on birch, 1907, at Solihull, Warwickshire, though neither the earlier stages or the male were taken.

Limothrips denticornis, Hal.

Three European species of thrips are known to infest cereal crops to a serious extent, namely *Limothrips cerealium,* Hal., *Stenothrips, graminum,* Uzel, and *Anthothrips aculeatus* (Fab.), and are, as a rule, found in large numbers. *Stenothrips* is recorded from Bohemia and Italy, but has not yet occurred in the British Isles.

Limothrips denticornis has not been regarded as a destructive insect, in fact it is a scarce species, and is usually found singly on various flowers and leaves. In looking over some material collected from cereals at Haydon Bridge, August, 1907, I was surprised to find that *L. cerealium* was not represented at all, its place being taken by *L. denticornis,* which was extremely abundant in all stages,

and it is interesting to note that the male, which is much smaller than the female and without wings, was more numerously represented than the female.

Euthrips orchidii, Moulton, 1907.

Euthrips orchidii, Moulton : U.S. Dept. of Agriculture, Bureau of Entomology, Tech. Ser., No. 12, pt. III, 1907, p. 52, pl. ii, figs. 15-18; Bagnall : Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 172.

This pretty little species occurs sparingly on various species of *Adiantum* in a propagating house, and on *Iresine, Begonia,* and other plants in the Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908.

Distribution.—California, U.S.A., four specimens from orchids (Bremner); Brussels, Belgium, sparingly on *Chamaeodorea fragrans* and commonly on *Ficaria* (R.S.B.); England.

Euthrips longipennis, Bagnall, 1909.

Euthrips longipennis, Bagnall : Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 173.

Another minute hot-house species which will probably be found to be widely distributed. Not uncommon on *Adiantum* and on various plants in the Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908.

Distribution.—Brussels Botanical Gardens, Belgium, on species of *Chamaeodorea,* chiefly *C. fragrans* (R.S.B.); England.

Euthrips inconsequens (Uzel), 1895.

Physopus inconsequens, Uzel : Mon. der Ordnung Thysanoptera, 1895, p. 117; Buffa : Atti della Soc. Tosc. di Sci. Nat., Memorie, xxiii, 1907, p. 61.

Several examples of the female in the young buds of a sycamore tree, Gibside, Co. Durham, May, 1907. I have had the advantage of comparing my specimens with co-types sent me by Professor Uzel.

Distribution.—Bohemia (Uzel); Italy (Buffa); England.

Euthrips pyri, Daniel, 1904.

Pear Thrips.

Euthrips pyri, Daniel : Ent. News, xv, No. 9, 1904, pp. 293-297; Moulton : U.S. Dept. of Agriculture, Bureau of Entomology, Tech. Ser., No. 12, pt. III, p. 53, pl. III, figs. 19-24, and *l. c.*, Bulletin No. 68, pt. I, 1907, pp. 1-16.

Mr. Walter E. Collinge, Director of the Cooper Research Laboratory, Berkhamsted, has sent me numerous examples of this very injurious species taken in Plum blossom, Evesham. *E. pyri* is a fruit tree pest which attacks nearly all varieties of deciduous fruits and has been responsible for more damage than any other known species of thrips, though, until now, only known from the San Francisco Bay counties and the Sierra Nevada foothills, California, U.S.A. During the season of 1905 large orchard sections, sometimes miles in length, suffered an almost complete failure of crops chiefly through the devastations of this small insect, and although Mr. Dudley Moulton and his assistants have studied the life-history, etc., of *E. pyri* very closely during the past four years, no really efficient check has been devised. What is evidently a true entomogenus fungus-parasite, *Cladosporium* sp., has been found to attack the different stages of the Pear thrips, and under certain conditions to help considerably in checking that pest, but its effectiveness can only be uncertain owing to the development of the fungus being to a very large extent subject to certain climatic conditions.

Those interested in the growth of deciduous fruits should refer to Mr. Dudley Moulton's very interesting and able memoir on the Pear Thrips referred to above. It is difficult to say to what extent this pest is distributed in Britain and all fruit-growers should make a point of examining the blossom of the different trees, and if thrips are present examples should be collected into tubes of about 70 per cent. alcohol and sent, with full data, to Mr. Collinge, or to the present writer, to be reported upon.

Male.—An example of the male is amongst the specimens submitted to me by Mr. Collinge; it is much smaller than the female and the wings considerably over-reach the tip of abdomen. Though countless specimens have been examined from the orchards of California, the male was never discovered, and this sex is therefore new to science.

Distribution.—California, U.S.A. (Miss Daniel, etc.); England.

Anaphothrips orchidaceus, Bagnall, 1909.

Orchid Thrips.

Anaphothrips orchidaceus, Bagnall: Ent. Mon. Mag., 1909, Sec. Ser., xx, p. 33; Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 171.

Since describing the Orchid Thrips from London, Northumberland, and Dublin, I have taken it at Glasgow (December, 1908) on *Cypripedium,* and have myself collected the perfect insect and larvae in the Kew Gardens, London, from *Epidendron* and *Cymbidium,* February 2nd, 1909.

It is a difficult pest to eradicate either by spraying or fumigation; immediately it is disturbed it seeks safety by rapidly running into the innermost recesses at the base of the leaves. It is now known from *Odontoglossum, Zygopetalum, Cypripedium, Cymbidium* and *Epidendron.*

Distribution.—England and Ireland (R.S.B.); Brussels, Belgium (R.S.B.); Scotland.

Leucothrips nigripennis, Reuter, 1904.

Fern Thrips.

Leucothrips nigripennis, Reuter: Meddel. af Soc. pro Fauna et Flora Fennica, 1904, xxx, pp. 106-109; Bagnall: Ann. de la Soc. Entomologique de Belgique, 1909, liii, p. 172.

A single specimen on a species of fern allied to *Pteris,* Glasgow, December, 1908, and numerous examples on *Adiantum,* and on various plants in the Palm House, Leazes Park, Newcastle-on-Tyne, during the same month.

Distribution.—Helsingsfors, Finland, on species of *Pteris* (Reuter); Brussels, Belgium, on *Davallia maguscula,* (R.S.B.); England and Scotland.

Heliothrips haemorrhoidalis (Bouché).

var. *abdominalis,* Reuter, 1892.

In hot-house with type, not uncommon, London, Cambridge, and Newcastle.

Heliothrips femoralis (Reuter).

Not uncommon in hot-house on a large variety of plants. Kew Gardens and Newcastle.

Parthenothrips dracaenae (Heeger).

A few specimens from Palm House, Leazes Park, Newcastle-on-Tyne, December, 1908. Have also received specimens from Kew Gardens, London, collected by the late George Nicholson.

Aptinothrips nitidulus, Hal.

Described in 1836 on specimens sent by F. Walker from England, and recently recorded by me from the Island of Arran, Scotland. In July, 1908, I found the species on *Aster tripolium,* near Arrochar, at the head of Loch Long, Scotland; and in September of the same year I again met with it at Portmarnock, near Dublin, on *Aster tripolium, Glaux maritima,* and *Juncus maritima.* Considering that the Portmarnock saltmarsh and sandhills were one of Haliday's classical hunting grounds it is strange that he did not take this species there.

Thrips salicaria, Uzel, 1895.

Thrips salicaria, Uzel: Mon. der Ordnung Thysanoptera, 1895, p. 162; Trybom: Entomologisk Tidskrift, 1896, xvii, p. 92; Reuter: Meddel. af Soc. pro Fauna et Flora Fennica, xvii, No. 2, 1899, p. 58.

Very local; several specimens on leaves of an old willow tree (*Salix* sp.), on the banks of the river Derwent, near Winlaton Mill, County Durham.

Distribution.—Bohemia (Uzel); Sweden (Trybom), and Finland (Reuter); England.

Thrips juniperina (Linn.), 1761.

Length, 1.0-1.2 mm.; breadth of mesothorax, 0.2 mm. General colour fuscous to greyish brown, legs (excepting coxae) and third antennal joint decidedly lighter, fore-edge of femora and tibiae slightly darker. Head not quite so long as wide, and slightly longer than the prothorax; cheeks widened behind eyes and from thence practically parallel, roughened; forehead evenly rounded between eyes, which are moderately prominent, occupying laterally one-

third the length of the head, the space between them being about the width of the two eyes together; black, coarsely faceted, and pilose. Ocelli sub-approximate, yellow with orange-red crescentic margins inwardly. Mouth-cone pointed, blackish at tip; maxillary palpi three-jointed, the second joint being the shortest, and the basal and apical joints sub-equal in length; tipped with three sensory filaments; labial palpi, with second joint very slender and much longer than the basal joint, which is very short. Antennae much longer than head, inserted beneath vertex and approximate at base; sixth segment the longest, about four times the length of the single-jointed style; third segment only slightly less than the sixth, longer than either the fourth or fifth.

Prothorax wider than head, and about twice as wide as long, transverse, sides parallel; two conspicuous bristles at each hind-angle, which are comparatively short, being about one-third the length of prothorax. Mesothorax longer than the prothorax and much wider, roundly widened from the fore-angles; metathorax shorter and abruptly narrower than the mesothorax, sides slightly accurate. Hind tibia armed with a strong spine at tip within. Wings fully developed, silvery white; veins weak; fore-wing with fore-margin and the hind-vein set regularly with conspicuous dark brown spines, fore-margin with about twenty-two, and 8-10 on hind vein; fore-vein with a series of three and three on basal half, and three scattered over distal half. Abdomen elongate-ovate, as wide as mesothorax, and a little more than twice as long as wide. Posterier edge of ninth segment encircled with eight long spines, and the tip of tenth segment with six similar, though shorter, spines.

Comes nearest *Thrips tabaci,* Lindeman, differing chiefly in the darker colour of the body, the broader prothorax, which is strongly transverse, the evenly-rounded frons, and in the colour of the wings and the number and arrangement of the spines on the fore-wing.

Whilst staying with my friend, Prof. Hudson Beare, at Nethy Bridge, Inverness-shire, July, 1908, I obtained a good deal of Thrips material from the Juniper bushes which abound in the forest near Nethy Bridge, and also from Juniper on the slopes of the Cairngorm Mountain. With the exception of a few stray examples of *Euthrips ericae* (Hal.), and of a very minute species of *Thrips* not yet identified, all were referable to a species of *Thrips,* s.s., which, owing to its food-plant, I can only presume to be the *Thrips juniperina* of Linnaeus. On p. 274 of his Monograph, Professor Uzel gives the synonym of *T. juniperina.* It was first recognised by De Geer in 1744 and described in the four words *Physapus*

fuscus, alis albicantibus,[1] and two years later Linnaeus described it as *Thrips elytris niveis, corpore fusco,*[2] but it was only in the year 1761 that he gave to it the name of *T. juniperina.* From 1761 to 1806 this species is mentioned in the works of De Geer, Goeze, Schrank, Fabricius, Gmelin, Berkenhout, de Villers, Stew, and Turton, and since then *T. juniperina* has been lost to science, sunk in oblivion only to be recognized again after the lapse of more than a hundred years! It should be here mentioned that in the year 1789 Berkenhout included *Thrips juniperina* in his "Synopsis of the Natural History of Great Britain and Ireland," whilst in 1836 Haliday specially states that he had "in vain searched on the Juniper and flax for *Thrips juniperina* and *Thr. variegata.*"[3] More recently, 1899, Prof. Reuter suggests with doubt that a species of *Aeolothripidae,* which he then described from *Abies* and *Convallaria,* namely *Rhipidothrips niveipennis,* Reut., was probably synonymous with *T. juniperina.*[4]

Thrips tabaci, Lindeman, (**communis,** Uzel).

One of the most injurious species of thrips. I have already recorded *T. tabaci* (under the name *communis*) as common on *Solanum dulcamara* and *S. tuberosa* in the North of England. It has apparently a very wide range of food-plants, and is often found in greenhouses. I have recently discovered it in large numbers and in all stages on *Iresine lindeni,* and other species of *Iresine* in propagating houses, Newcastle, London, and abroad, chiefly on plants infested by *Aphis.*

Platythrips tunicatus, Hal.

A rare species of which I have taken a single example of the female on *Vaccinium* at Corbridge-on-Tyne, July, 1908.

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[1] K. Swenska Wetensk. Acad. Handl., V, p. 3, pl. 1, fig. 2.
[2] Fauna Suecica, Ed. l., p. 221.
[3] Ent. Mag., iii, p. 451.
[4] Acta Soc. pro Fauna et Flora Fennica, xvii, No. 2, p. 20.

A STEM BORING BEETLE ATTACKING COTTON IN THE SUDAN.

By

HAROLD H. KING,

Wellcome Research Laboratories, Khartoum.

With Plate V.

During April, 1907, the writer's attention was called to some cotton in the province of Berber, which was dying from some unknown cause. On investigation the lower portion of the stem was found to be attacked by the larva of one of the *Buprestidae*, but efforts made at the time to breed out the adult were unsuccessful. No further opportunity for studying the bionomics of this pest occurred until the summer of 1908, when the egg, pupa, and adult were obtained.

Specimens of the adult have been sent to Mr. C. O. Waterhouse, of the British Museum, who very kindly identified it as a member of the genus *Sphenoptera,* probably *S. neglecta,* Klug. The larva of a member of the same genus—*S. gossypii*—is recorded by Lefroy[1] to attack cotton in Bombay, Central Provinces and the Punjaub. Possibly the species here noted may prove to be identical with the Indian cotton stem borer.

Distribution in the Sudan.—The cotton stem borer has been recorded from the estate belonging to the Sudan Plantation Syndicate, Ltd., at Zeidah, Taragma, both in Berber Province and the Government Experimental Farm at Halfyia, Khartoum Province.

Host Plants.—This beetle has not been noticed by the writer to attack any other plant but cotton.

Description.—Egg (Figs. 1 and 5). Length, 1.25-1.50 mm. The embryo is enveloped in a thin, transparent to whitish membrane, which is covered by a dull, greenish blue, scale-like shell, in shape roughly oval, and bearing a number of irregular crinkles or ridges.

Larva (Fig. 2). Length up to 29 mm. Colour, head brown, mandibles black, thorax and abdomen yellowish white. The larva is of the typical Buprestid shape, the small head being retracted into the broad, flattened, first thoracic segment, and the abdomen being long and comparatively slender. The first thoracic segment bears both a dorsal and a ventral shield, the former being cut by a longitudinal median groove not quite extending to the anterior

[1] Bull. Imp. Institute, 1907, Vol. v, No. 2, pp. 164, 5.

border, and the latter by a Y-shaped, forwardly pointing groove, also barely reaching to the anterior border. The remainder of the body is flattened and wrinkled. The anus is situated at the apex of the terminal segment. The whole body bears a few scattered short pale hairs.

Pupa. (Fig. 3). Colour, yellowish white, eyes dull purple.

Adult. (Fig. 4). Length, 9-10.5 mm. Colour, greenish to reddish bronze.

When first it emerges from the pupal cell the beetle is covered with a fine yellowish meal, especially on the frons, sides of the pronotum, prosternum, metasternum, and venter generally. Head, pronotum, scutellum and venter, reddish bronze, irregularly punctured, and bearing a few scattered, short, pale hairs. Mesonotum and metanotum bright, metallic green, punctured. Metanotum bears a V-shaped backwardly pointing groove or gutter, in which is a median ridge, black. Dorsum of abdomen bright metallic green, punctured, and bearing a few scattered, short, pale hairs, with the exception of the basal margins of the segments, and a longitudinal median ridge, which are smooth, and have a bronzy tinge. Antenna of twelve segments—first, small, globular; second, elongated, swollen; third and fourth, smaller; remainder of antenna serrate. Elytrum reddish bronze, with punctures arranged in longitudinal rows, ridged towards the apex, and terminating in three short spines. Hind wing slightly clouded, especially towards the apex; costa terminates in a short spine; apical margin irregular. Tibiae with longitudinal rows of short, sharp spines; fore tibiae bear at the apices one longer spine, mid and hind tibiae two similar spines.

Habits and Life History.—The eggs are deposited singly, on the bark of the plant, on either the main stem or the branches—usually the former—and preferably in a crevice or wound. As many as nine eggs have been found on a stump of caravonica cotton, scarcely twelve inches high, but these had probably been laid by several beetles.

On hatching, the larva burrows into the stem, without rupturing the external shell of the egg, and commences a tortuous tunnel in the wood. Frequently this tunnel runs immediately under the bark for some distance, but it may go deeper into the wood, especially as the larva grows older, and may even, in the case of smaller branches, follow the course of the pith. It may also extend below the level of the ground. As the larva proceeds it packs the tunnel behind it with grass and wood chips, which, at first light in colour, become

dark brown in course of time. It invariably lies in its tunnel in a doubled-up position.

On attaining maturity the larva hollows out for itself a little chamber, usually near the bark, and pupates with its head end pointing towards the bark. The adult eventually gnaws a circular hole through the bark and makes its exit.

Duration of the Life Cycle.—This pest has not been followed by the writer throughout the whole of its life cycle, but the observations made indicate that there are two broods in the course of the year. The season for planting cotton is June and July, and the crop is picked by the end of March. The cotton wood is then usually collected and stocked, to be used later for fuel. The eggs of the first brood of borers can be found on young cotton in August and September, and the adults resulting from these emerge and oviposit in March. The larvae of this second brood probably complete their development in dead wood.

Damage Done by the Borers.—Plants infested by the borers are not usually killed outright, but live to the end of the season, though reduced in vitality. The borers are, however, frequently the indirect cause of the death of the plant, as white ants—termites—which will not, as a rule, attack healthy, living plants, readily attack those which have been weakened by the work of the beetle larvae.

Methods of Control.—The measures usually recommended for the control of the cotton boll-worms—*Earias insulana* and *Diparopsis castanea,* Hamp.—and the cotton stainer—*Oxycarenus hyalinipennis* —should be of benefit against the stem-borer. These measures are clean cultivation, the use of trap crops, and the burning as soon as is practicable of the cotton wood after the crop has been gathered.

EXPLANATION OF PLATE V.

Illustrating Mr. Harold H. King's paper on "A Stem Boring Beetle attacking Cotton in the Sudan."

Fig. 1.—Egg, much enlarged.

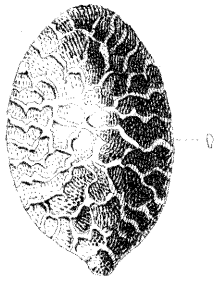
Fig. 2.—Larva, enlarged.

Fig. 3.—Pupa, ,,

Fig. 4.—Adult, ,,

Fig. 5.—Portion of stem of cotton plant, shewing egg *(a)* and exit hole of adult *(b)*.

Fig. 6.—Longitudinal section of stem of cotton plant shewing tunnels made by borers.



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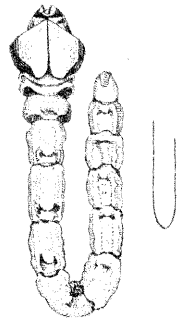

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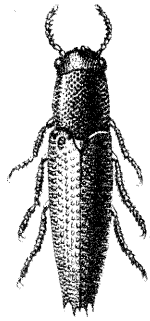

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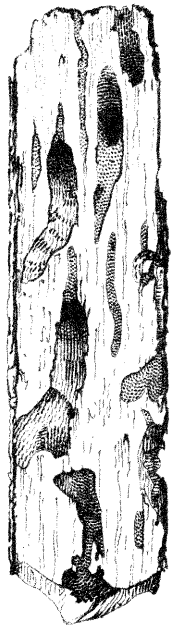

6.

C. Beard del. Huth sc. et imp.

COTTON STEM BORING BEETLE.

DESCRIPTION OF A NEW GENUS OF COLLEMBOLA OF THE FAMILY *NEELIDAE*, FOLSOM.

By

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

AND

JOHN W. SHOEBOTHAM, N.D.A.

WITH PLATE VI.

THE Genus *Neelus* was constituted by Folsom[1] in 1896 for a minute species of Collembola (*N. murinus*) found in a greenhouse in Cambridge, Mass., U.S.A., and which has since been found in Belgium by Willem,[2] and in Calabrien and Sicily by Börner.[3]

In 1901 Folsom[4] described a further species, *N. minutus,* from an old pine forest in Arlington, Mass., and this as yet has not been recorded from any other locality.

A closely allied genus, *Megalothorax,* was described by Willem[5] in 1900 for a small Collembolan obtained at the Botanic Gardens, Ghent, Belgium, and which has since been obtained from various European localities.

Börner[6] in 1903 added a second species, *M. incertus,* from Sicily.

Neither of these genera have until now been recorded for the British Isles.

Some few months ago one of us (J. W. S.) collected a number of minute Collembola in a greenhouse in the garden of the Rev. Canon A. M. Norman, F.R.S., Berkhamsted, and upon examination we find these to be closely allied to both of the above-mentioned genera, but differing in important structural characters.

Since collecting the above we have found a second member of the *Neelidae* in Berkhamsted (*Neelus murinus,* Folsom).

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[1] Psyche, 1896, vol. vii, pp. 391, 392, plt. 8.

[2] Ann. Ent. Soc. Belg., 1902, pp. 282, 283.

[3] Sitzber. Ges. Nat. Freund. Berlin, 1903, p. 160.

[4] Psyche, 1901, vol. ix, pp. 219-222, plt. 2.

[5] Ann. Soc. Ent. Belg., 1900, vol. 44, pp. 7-10, pl.

[6] *Op. cit.*, p. 160.

The Family *Neelidae* is of special interest in that the members exhibit a number of very generalised characters which, in part, form a link between the globular Sminthurid forms and the cylindrical Podurid ones, such for instance as the extension of the thorax and the greater mobility of the limbs, the short ventral tube and tuberculate papillae, the articulation and position of the head, and the form of the antennae.

The family *Neelidae* was constituted by Folsom in 1896,[1] but after the description of the genus *Megalothorax* by Willem in 1900,[2] he expressed the view that Willem's genus could not stand, being practically the same as *Neelus,* and further that this genus should be assigned to one family with *Sminthurus* and *Papirius*. With this view, however, few if any authors will agree, as the two above-mentioned genera are perfectly distinct, and undoubtedly find their proper places in a separate family that will precede the *Sminthuridae*.

We have not been able to examine examples of *Megalothorax,* but Börner's beautiful figures[3] are at once sufficient to show the close relationship of this genus to *Neelus,* and at the same time clearly indicate its distinctiveness from it and from that here described.

From a careful study of the description and figures of the known genera and species, together with the new genus (*Amerus*) and species here described, we believe there to be good grounds for regarding this latter genus as the most primitive, followed by *Megalothorax*, and then *Neelus*.

Family NEELIDAE, Folsom.
Psyche, 1896, vol. vii, p. 391.
= MEGALOTHORACIDAE, Börner.

Body globular in form, with the thoracic segments dominating. Segmentation somewhat indistinct. Almost naked. Abdomen situated ventrally; anal tubercle absent. Head horizontal, or vertical, broadly articulate. Antennae four-jointed, shorter than the head; last segment not ringed. Legs well separated. Ventral tube with tuberculate processes. Eyes absent. No post-antennal organ. No tenent hairs. Mid-gut divided into four spherical compartments. No tracheae.

The leading characters of the three known genera are set forth in tabular fashion for the purpose of comparison.

[1] *Op. cit.*
[2] *Op. cit.*
[3] Wytsman's Genera Insectorum, 1906, pp. 1-5, 1 plt.

Amerus.	Megalothorax.	Neelus.
Head.—Vertical admitting of little movement being almost continuous with the body.	Vertical, but admitting of movement, being distinctly separated from the body.	Horizontal and movable being distinctly separated from the body.
Antennae.—Comparatively short and thick, 4-jointed.	Comparatively short and thick, 4-jointed.	Comparatively long and thin or short and thick, 4-jointed.
In all three cases shorter than the head.		
Segmentation.—Not distinct.	Fairly distinct.	Not distinct.
Furcula.—Consists of 4 segments with pair of abdominal appendages (?) fused with the manubrium. Mucro proximally deeply concave, distally lanceolate, non-dentate.	Consists of 4 segments. Mucro somewhat spatulate, non dentate.	Consists of 3 segments. Mucro lanceolate and dentate.
Ventral tube.—Simple.	Simple.	Sub-clavate with a posterior lobe, and tuberculate processes.
Eyes and post-antennal organs.—Absent.	Absent.	Absent.
Tracheae and Tenent Hairs.—Absent.	Absent.	Absent.

Amerus normani, n. gen. et sp.

Pl. VI, figs. 1-5.

Body globular and almost naked, a few hairs round the mouth, dorsally on the head and thorax and on the antennae, limbs and abdomen. The ground colour is a milky-white, with a little reddish-brown colouring dorsally and laterally, giving the body a somewhat mottled appearance. Head vertical and not very distinct from the thorax. Thorax longer than the abdomen. Segmentation

very indistinct. Eyes and post-antennal organs absent. Antennae short and thick, four-jointed, the distal segment the longest. Legs long and slender, articulating ventro-laterally. Each foot terminates in two claws, the upper of which is long and curved, and has a long, fine tooth (pseudonychium) at each side. Under claw short and broad, with a short, blunt tooth on its inner side. No anal tubercle. Furcula consists of four segments, with stout manubrium; what appear to be a vestigial pair of abdominal appendages are attached to the latter. Mucro somewhat spatulate, terminating in a solid lanceolate piece. No tenent hairs.

Length.—0.3 mm.

Hab.—Berkhamsted, under flower pots in a greenhouse, also under decaying wood by the side of a footpath.

Undoubtedly a very primitive form of Collembola.

We have much pleasure in associating the name of the Rev. Canon A. M. Norman, F.R.S., with this interesting species, to whom we are greatly indebted for his kindness in permitting us to make every use of his grounds for collecting purposes and for other assistance.

Genus **Neelus**, Folsom.

Psyche, 1896, vol. vii, pp. 391-392, plt. 8; ibid., 1901, vol. ix, pp. 219-222, plt. 2.

Body globular and almost naked; prothorax slightly reduced dorsally, mesothorax not reduced, metathorax conspicuously long. Abdomen swollen before the manubrium. Head ovate horizontal or subhorizontal, broadly articulated. Thorax longer than abdomen. Anal tubercle absent. Eyes and post-antennal organs absent. The antennae are short, consisting of four segments. Legs long and slender, both claws present on feet. Furcula composed of three segments twice as long as the antennae; manubrium stout, distally bifid; dentes cylindrical in lateral aspect; mucrones elongate lanceolate with serrated edges. Setae short and few. Ventral tube sub-clavate, with a posterior lobe and tuberculate processes.

N. murinus, Folsom.

Psyche, 1896, vol. vii, pp. 391-392, plt. 8.

"General colour ochraceous-buff, in alcoholic specimens ochraceous-orange; when young, white with a dorsal longitudinal median ill-defined buff stripe; head paler; antennae, legs and furcula white. Head horizontal, in lateral view ovate, half as long as body, smooth, anteriorly with short setae. Eyes absent. Antennae

shorter than the width of the head, not geniculate, slender, segments four, their respective lengths as 1, 3, 5, 5; basal segment globose, naked; second subcylindrical, sparsely hairy apically; third cylindrical, subpetiolate, more hairy; terminal segment long-conical, with hairs curving towards the notched apex. Labrum and labium projecting, with stout setae. Mandibles with long, falcate-oblong apex; terminal tooth long, sinuate within; lower incisive teeth small, three and four, compressed; below the base of the apex is a prominent rounded lobe directed forward; molar surface little convex, minutely denticulate, bounded on one side by a longitudinal row of four, or three large, blunt teeth, respectively dorsal and ventral on the right and left mandibles; molar surface with a slight posterior lobe. Maxillae with a conspicuous, dorso-external, curved acuminate claw; ventral and internal to this, a wavy, linear process bearing on distal half an external comb of long teeth; remainder of maxilla composed of two large, oblong, concaved appendages, each with four or five ribs terminating in as many teeth on the anterior truncated margin. Body seen from above oval, smooth; in profile with high-arched dorsal outline; smooth excepting a few bristles on the inconspicuous anal tubercle. Prothorax compressed, broadly articulated with the head. Ventral surface white, much swollen before the manubrium. Ventral tubes equal to dentes in length, cylindrical, crenate anteriorly, one-lobed posteriorly near base, ending in two semi-globose papillate tubercles. Legs slender, about as long as furcula, scarcely bristly except on tibia. Superior claw as long as third antennal segment, slender, internally sinuate with one sharp tooth one-third from apex; a linear pseudonychium, as long as the inferior claw, arises from either side the base of the external margin of superior claw. Inferior claw less than half the other in length, uniformly tapering, scarcely curving with the superior claw, smooth, not toothed; tenent hairs absent. Furcula short, scarcely reaching mesothorax; segments ventrally as 1, 1.5, 1; manubrium stout, swollen, with a few ventral hairs and sinuate distal articulation; dentes laterally a little tapering, distally with five large, lateral teeth at intervals, three being external and two internal, also a long subapical ventral bristle, and an evident, blunt-conical, apical lobe on either side the base of the mucro; mucrones laterally narrowly lanceolate, deeply concave ventrally with each edge distinctly serrate and with simple apex.

Maximum length, 0.7 mm."

Hab.—Berkhamsted. Under flower pots in a greenhouse, also under sticks in a wood.

EXPLANATION OF PLATE VI.

Illustrating Messrs. Collinge and Shoebotham's paper on "Description of a New Genus of Collembola of the Family *Neelidae*, Folsom."

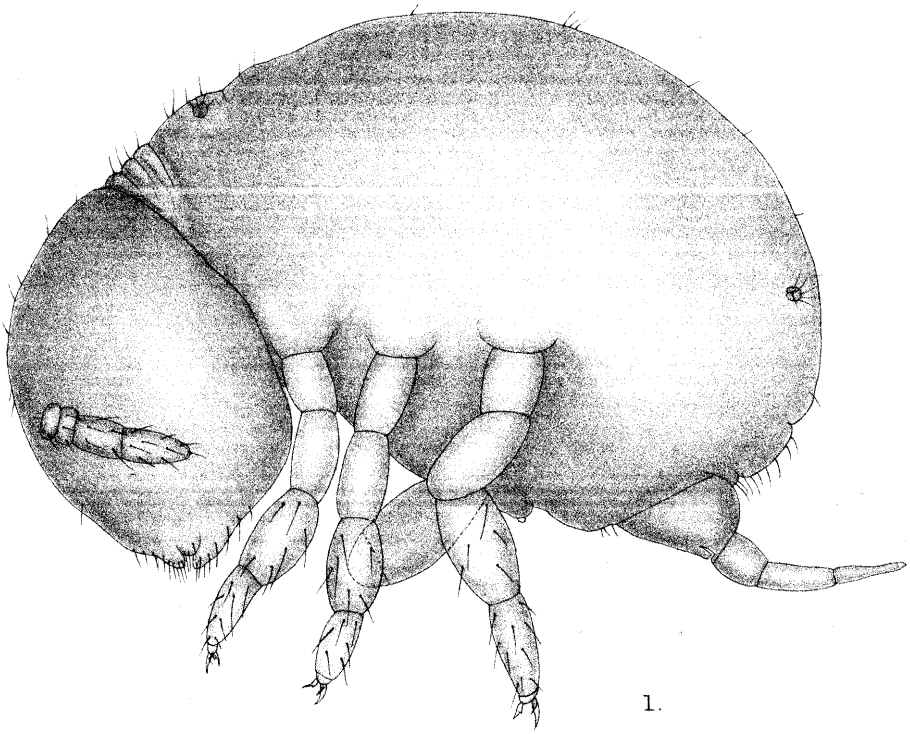
Fig. 1.—*Amerus normani*, gen. et sp. nov. Drawn from mounted specimen.

Fig. 2.— „ „ Lateral view of the right antenna.

Fig. 3.— „ „ Claw of 3rd foot.

Fig. 4.— „ „ Extended furcula seen from below, showing pair of vestigial abdominal appendages. *v. app.*

Fig. 5.— Mucro seen from above.



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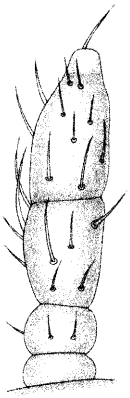

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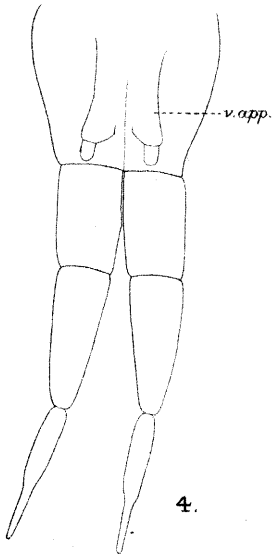

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J.W.S. del. ad nat. Huth. sc. et imp.

AMERUS NORMANI, gen. et sp. nov.

REVIEWS.

Bateson, W.—Mendel's Principles of Heredity. Pp. xiv + 396, 6 plts., 37 figs. and 3 portraits. Cambridge: The University Press, 1909. Price 12s. net.

The story of Mendelism is here set forth with a fulness and lucidity that all who are, or wish to be, students of the subject will hail with delight.

It is very largely owing to the enthusiasm and work of Professor Bateson that the subject has reached the position it now occupies in the minds of biological investigators. It matters little for the present moment whether or not the work which the author has stimulated will bear the later scrutiny of strict criticism; indeed, the time is not ripe for such; further experimentation is what is most needed, in spite of the great mass of evidence which Professor Bateson sets forth. Fortunately the work already achieved has been spread over a wide range of subjects, many of great economic importance, and further and extended work will, in all probability, lend further support to the Mendelian position

The author states in his preface that the object of his book "is to give a succinct account of discoveries in regard to Heredity made by the application of Mendel's method of research. Following the clue which his long-lost papers provided, we have reached a point from which classes of phenomena, hitherto proverbial for their seeming irregularity, can be recognized as parts of a consistent whole. The study of Heredity thus becomes an organised branch of physiological science, already abundant in results, and in promise unsurpassed."

Such an account he has given, together with many interesting biographical details of Mendel, and an admirable bibliography of the subject.

For these and the many other features set forth in this work naturalists generally will be deeply grateful. No one interested in biological thought can afford to neglect a book beautifully written, full of interest and bristling with suggestions for further investigations.

W. E. C.

Deegener, P.—Die Metamorphose der Insekten. Pp. ii + 56. Leipzig n. Berlin: B. G. Teubner, 1909. Price 2s.

In this small volume of 56 pages the author gives a valuable and suggestive discussion on the ever fresh and fascinating subject of insect transformation. After a short sketch of the conflicting views of those

who regard the larvae of the higher insects as representing a true phylogenetic stage, and of those who consider larval structures to be special, temporary adaptations for the early life of the individual, Dr. Deegener points out the varying relations that occur between the larval and imaginal organs; thus normal insectan organs well-developed in the larva, but reduced or wanting in the imago, are "primitive," while structures specially developed for larval life and absent or normally developed in the perfect insect, are "provisional." From such facts the author supports in his subsequent discussion on the phylogeny of metamorphosis, the view that the larva among the higher insects has been specialized—even if by degeneration—and has thus become markedly unlike the imago. In this conclusion he is in agreement with most modern students of the life of insects. An interesting discussion of the pupal stage concludes the work, in which attention is called to the phylogenetic import of the ephemerid sub-imago.

Dr. Deegener's arguments are well worthy of attention from all earnest students.

G. H. .

Lankester, Ray.—A Treatise on Zoology. Part vii. Appendiculata. Third fascicle Crustacea, by W. T. Calman. Pp. viii + 346, 194 figs. London: Adam and Charles Black, 1909. Price 15s. net.

To this already valuable treatise Dr. Calman adds a volume upon the Crustacea, which is a most valuable epitome of Crustacean morphology.

The author first succinctly summarises our ideas upon the Crustacea as a Class, and then passes on to review the various Orders. From the standpoint of either the morphologist or systematist little seems to have been omitted, and one wonders how ever he has so thoroughly summarised the whole of the Orders in so few pages.

Specially interesting are the accounts of the Cirripedia, Syncarida, Tanaidacea, and Isopoda, whilst the remaining Orders are treated in a manner leaving little if anything to be desired.

We look forward with considerable interest to the remaining volumes dealing with the Appendiculata, in the meantime students of zoology in general, and carcinologists in particular are under a debt of gratitude to the author for having provided them with an admirable text-book, replete with the very latest information, and carefully and concisely written.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Ballou, H. A.—Millions and Mosquitos. W.I. Bull., 1909, vol. ix, pp. 382-390, 4 figs.

Cooley, R. A.—Photomicrography of the *Diaspinae*. Journ. Econ. Entom., 1909, vol. 2, pp. 95-99.

Felt, E. P.—Control of Household Insects. N.Y. State Mus., Bull. 129, 1909, pp. 1-47, figs. 1-34.

The well-known works of Howard and Marlatt, John B. Smith, and Froggatt leave little to be said upon the subject of household insects, but in view of the importance of the subject it is just as well that it should be said often, and Dr. Felt's useful bulletin once more emphasises the seriousness of the subject regarded from the health standpoint.

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Smith, J. B.—The House Mosquito, a City, Town and Village Problem. New Jersey Agr. Exp. Stat., Bull. 216, 1908, pp. 1-21, 9 figs.

Webster, F. M.—The Importance of Proper Method in Entomological Investigations. Journ. Econ. Entom., 1909, vol. 2, pp. 99-108.

II.—Anatomy, Physiology, and Development.

Nuttall, G. H. F., Cooper, W. F., and Robinson, L. E.—On the Structure of the Spiracles of a Tick—*Haemaphysalis punctata,* Canestrini and Fanzago. Parasitology, 1908, vol. i, pp. 347-351, plts. xxii, xxiii.

Stephens, J. W. W.—Observations on the Hooklets of *Cysticercus cellulosae* in Man. Ann. Trop. Med. and Par., 1909, vol. ii, pp. 391-395, figs. 1-4.

III.—General and Systematic Biology, and Geographical Distribution.

Bagnall, R. S.—The Bristle-tails (Thysanura) of the Derwent Valley. Trans. Vale of Derwent N. Field Club, 1908, vol. 1, pp. 26-30.

Mr Bagnall brings to light again the *Praemachilis brevicornis* (Ridley).

Bagnall, R. S.—Preliminary Description of a new and injurious Thrip. Entom. Mon. Mag., 1909, p. 33.

Beare, T. H., and Evans, W.—Coleoptera from Moles' Nests in the South-East of Scotland. Ann. Scot. N.H., 1909, pp. 86-91.

Bezzi, M.—Le specie dei generi *Ceratitis, Anastrepha e Dacus*. Boll. Lab. Zool. gen. e agrar. Portici, 1909, vol. iii, pp. 273-313, figs. 1-3.

A very hopeful review and revision with an excellent bibliography.

Cockerell, T. D. A.—Two Fossil Bees. Entom. News, 1909, pp. 159-161.

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Collinge, Walter E.—The Life-history and Habits of the Woolly Aphis (*Schizoneura lanigera*, Hausm.). Journ. Cooper Research Lab., 1909, pp. 28-37, 3 figs.

Davis, J. J.—Biological Studies on three Species of *Aphididae*. U.S. Dept. Agric., Bur. of Entom., No. 12, pt. viii, 1909, pp. 123-168, 4 figs.

Essig, E. O.—*Aphididae* of Southern California. 1. Pomona Journ. Entom., 1909, vol. i, pp. 1-10, 7 figs.

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Gowdey, C. C.—The *Aleyrodidae* of Barbados. W.I. Bull., 1909, vol. ix, pp. 345-360, 18 figs.

Lefroy, H. M.—Notes on Indian Scale Insects (*Coccidae*). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 7, pp. 111-137, plts. x-xii.

An interesting paper giving many details and life-histories, and well illustrated.

It is a great pity that this excellent series of publications are not edited in a better manner. In the one before us we note that specific names are spelt with a capital letter in some places, and in others with a small

letter; that all the names of authorities are enclosed in brackets; that the plates are sometimes numbered at the top right-hand corner, and in other cases at the top and in the middle. Greater uniformity is highly desirable.

Masi, L.—Contribuzioni alla conoscenza dei Calcididi Italiani. Boll. 1909, vol. iv, pp. 1-37, 29 figs.

The following new species are described and figured: *Encyrtus vinulae, Habrocytus hyponomeutae, Prospaltella lutea, Encarsia partenopea, Cocoophagus niger,* and *Physcus testaceus.* Figures and full descriptions are also given of other species.

Nalepa, A.—Neue Gallmilben (30 Fortsetzung). Sitz. Ak. Wien, 1909, No. x, pp. 1, 2.

The author describes *Eriophyes crassipunctatus* and *E. magalonyx,* both new sub-species of *E. machrochelus,* Nal., also *E. paderineus,* n.sp. and *E. protrichus. E. fraxinivorus* is a new name proposed for *E. fraxini* (Karp. 1884, non Garman, 1882), and *E. ulmicola* for *E. ulmi,* Nal., 1890 (non Garman, 1882).

Nalepa, A.—VI Eriophyiden. Denks. Akad. Wiss. Wien, 1908, Bd. lxxxiv, pp. 1-14, Tafn ii, iii.

Nalepa, A.—Eine Gallmilbe als Erzeugerin der Blattgallen von *Cinnamomum zeylanicum,* Breyn. Marcellia, 1909, vol. viii, pp. 3-6.

Eriophyes doctersi, n.sp.

Newell, W.—The Life-history of the Argentine Ant, *Iridomyrmex humilis,* Mayr. Journ. Econ. Entom., 1909, vol. 2, pp. 174-192, plts. 5-7, and 4 figs.

Rehn, J. A. G.—On Brazilian Grasshoppers of the Subfamilies *Pyrgomorphinae* and *Locustinae* (*Acridinae* of Authors). Proc. U.S. Nat., Mus., 1909, vol. xxxvi, pp. 109-163, 38 figs.

Silvestri, F.—Tisanuri raccolti da L. Fea alle isole del Capo Verde, alla Guinea Portoghese e alle isole S. Thomè, Principe e Fernando Poo. Ann. Mus. Civ. Storia Nat. Genova, 1908 (s.3), vol. iv, pp. 133-187, figs. i-xxiv.

The author describes 6 new species from Cape Verde Is., 5 from Portuguese Guinea, 3 from Is. of St. Thomas, 1 from Princes Is., and 5 from the Is. Fernando Po. From the latter island 3 new genera are described, viz., *Olarthrocera, Monachtinella,* and *Subnicoletia.*

The descriptions are illustrated by numerous figures.

Silvestri, F.—Descrizioni preliminari di varii Artropodi, specialmente d'America. R. Acc. d. Lincei, 1909, vol. xviii, pp. 7-10.

Prof. Silvestri describes the following new genera and species: *Projapyx incomprehensus, Symphylurinus* (gen. nov.) *grassi, Anajapyx mexi-*

canus, from material in the United States National Museum; also a new Proturan from New York, *Eosentomon wheeleri* and var. nov. *mexicanum* of that species.

The *Acerentomon minimum* of Berlese he places in a new genus to which he gives the name *Proturentomon.*

Smith, R. I.—Biological Notes on *Murgantia histrionica,* Hahn. Journ. Econ. Entom., 1909, vol. 2, pp. 108-114.

IV.—Agriculture and Horticulture.

Baker, C. F.—Plant Louse Parasites. 1. Pomona Journ. Entom., 1909, vol. i, pp. 22-25.

Ball, E. D.—Is Arsenical Spraying killing our Fruit trees? Journ. Econ. Entom., 1909, vol. 2, pp. 142-148.

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Chittenden, F. H., and Russel, H. M.—The Semitropical Army Worm (*Prodenia eridania,* Cram.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. v, 1909, pp. 53-70, 4 figs.

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Cook, A. J.—The Red Scale (*Chrysomphalus aurantii,* Mask.). Pomona Journ. Entom., 1909, vol. i, pp. 15-21, 5 figs.

Eriksson, J.—Gooseberry Mildew and Gooseberry Cultivation. Journ. Roy. Hort. Soc., 1908, vol. xxxiv, pp. 469-472.

Fletcher, J.—Report of the Entomologist and Botanist. 1907-1908. App. to the Rpt. Min. of Agr., Ottawa, 1908, pp. 183-213, 1 plt.

Fuller, Claude.—The English Sparrow. Natal Agric. Journ., 1909, pp. 76-80, 1 fig.

Fuller, C.—Second Annual Report of the Committee of Control of the South African Central Locust Bureau. Pp. iv + 86. Cape Town, 1909.

Fortunately we scarcely understand in the British Isles what a serious plague of insects means, but the Report before us vividly brings home to us what such means to other countries. Mr. Claude Fuller, the Government Entomologist of Natal, informs us that the total funds expended in South Africa in connection with the past season's work on locust destruction, was, approximately, £40,000, and while the work is not expected to lead to the total eradication of these insects, it undoubtedly has diminished their numbers, and further the knowledge acquired cannot fail to prove a most valuable asset for the future.

Garman, H.—The Army Worm. Kentucky Agric. Exp. Stat., Bull. No. 137, 1908, pp. 431-449, 16 figs.

No indication of what species this is, from the figures we take it to be *Leucania unipuncta,* Haworth.

Gates, B. N.—A Method of securing Apicultural Statistics. Journ. Econ. Entom., 1909, vol. 2, pp. 117-120.

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Marlatt, C. L.—How to Control the San Jose Scale. U.S. Dept. Agric., Bur. of Entom., Circ. No. 42, 5th ed., 1909, pp. 1-7.

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Sanderson, E. D.—Notes on recent experiments for the control of the Codling Moth. Journ. Econ. Entom., 1909, vol. 2, pp. 135-142.

Schoene, W. J.—The Tussock Moth in Orchards. N.Y. Agr. Exp. Stat., Geneva, Bull. No. 312, 1909, pp. 39-49, plts. i-iii.

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Stewart, F. C., and Others.—Potato Spraying Experiments in 1908. N.Y. Agr. Exp. Stat., Geneva, Bull. No. 311, 1909, pp. 1-38.

Stockdale, F. A.—Fungus Diseases of Cocoa-Nuts in the West Indies. W.I. Bull., 1909, vol. ix, pp. 361-381.

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Wilson, H. F.—The Peach-tree Barkbeetle (*Phlaeotribus liminaris,* Harr.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. ix, 1909, pp. 91-108, plts. x-xii and 3 figs.

V.—Forestry.

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VI.—Fisheries.

Shipley, A. E.—Note on the occurrence of *Triaenophorus nodulosus,* Rud. in the Norfolk Broads. Parasitology, 1908, vol. i, pp. 281, 282, 1 fig.

VII.—Medicine.

[**Anon.**]—The Röntgen Ray Treatment of Ringworm. Lancet, 1909, May 15th, pp. 1399-1400.

Duval, C. M., and Todd, J. L.—A Note on the Cultivation of *Spirochalta duttoni*. Lancet, 1909, March 20th, pp. 834, 835.

Howard, L. O.—Economic Loss to the People of the United States through Insects that Carry Disease. U.S. Dept. Agric., Bur. of Entom., Bull. No. 78, 1909, pp. 1-40.

Dr. Howard points out that "the United States is just awakening to the knowledge of the disastrous results following a lack of appreciation of the danger arising from the unchecked development of mosquitoes and the typhoid fly, and it is hoped that the bulletin will not only emphasise this danger, but will also lend support to movements, both local and widespread, towards the destruction (often so easy) of these carriers of disease."

He proposes the name "typhoid fly" as a substitute for the name "house fly," which insect people have altogether too long considered as a harmless creature, whereas it is a most dangerous one from the standpoint of disease. "That a creature born in undescribable filth and absolutely swarming with disease germs should practically be invited to multiply unchecked, even in great centres of population, is surely nothing less than criminal."

We commend this bulletin to the notice of all Medical Officers of Health.

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Mohler, J. R., and Washburn, H. J.—Tuberculosis of Hogs: its Cause and Suppression. U.S. Dept. Agric., 24th Ann. Rpt. Bur. of An. Ind., 1909, pp. 215-246, plts. ii-v.

Ross, E. H.—A Gregarine Parasitic in the Dog Flea, *Ctenocephalus serraticeps*. Ann. Trop. Med. and Par., 1909, vol. ii, pp. 359-363.

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THE

JOURNAL OF ECONOMIC BIOLOGY.

ON THE RELATION OF CERTAIN CESTODE AND NEMATODE PARASITES TO BACTERIAL DISEASE.[1]

BY

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"*BY A WORM'S PIN-PRICK.*"

A Lover's Quarrel. R. BROWNING.

IN Volume No. I. of *Parasitology*[2] I described some Nematode worms living in the swim-bladder of certain rainbow trout, taken on the estate of the Hon. Sydney Holland, near Royston. The trout were dying in considerable numbers, being found standing on their heads in the stream in a dead or moribund condition. They were *déséquilibrés,* and seemed "to suffer from some derangement of the swim-bladder; they swim always on the surface on the water and die with their heads downwards and the body almost, if not quite, perpendicular to the surface of the water. They die, as Mr. Holland tells me, not only in deep water, but occasionally in the shallow water of the spawning beds." "Last year, however, during the period of greatest mortality, when six or seven trout were dying a day, until some 50 out of 200 were dead, they never tried to work up stream to the spawning beds, but died in the deep water. The fish seemed to have difficulty about shedding their ova, and it may be that this difficulty is connected with the cause of the mortality, but males died with the same symptoms as females, though not in such large numbers. Since the spawning season finished this year there have been no deaths. Curiously, too, the rainbow trout are alone affected and not the brown trout."

The Nematodes belong to the species *Cystidicola farionis,* Fischer, and their structure has been described by Mr. R. T. Leiper

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

[2] "Parasitology," 1908, vol. I, pp. 190-2.

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in the same number of "Parasitology." Their presence caused no visible lesions. Here for a time the matter rested. But this summer Mr. G. H. Drew, of the Marine Biological Association, Plymouth, was able to carry the research somewhat further. He investigated some of the trout preserved in formalin, and he paid a visit to Royston to inspect the trout on the spot. I have ventured to quote the following paragraphs from his paper which will shortly appear:—

"In every case from 10 to 30 specimens of *Cystidicola* were present in the swim-bladder, and in many cases a small amount of a fibrino-purulent material was adherent to the walls. Smears of this exudation were made, fixed by heat, and stained with methylene blue. Under the microscope these slides showed many leucocytes, fibrin, and large numbers of bacteria. The leucocytes were somewhat degenerated, but many of them showed phagocytosis: many different forms of bacteria were present. Preparations of the walls of the swim-bladder showed dilatation of the capillaries with transmigration of leucocytes and some fibrin formation. The condition was typically that which would be produced by infection of a serous cavity with bacteria."

"Through the kindness of Mr. Holland I was able to go to Royston and investigate the matter on the spot. Eight fish were caught and dissected, and of these seven were infected with *Cystidicola*. These seven all showed signs of inflammation of the swim-bladder and smears showed the presence of many bacteria and distinct pus formation: the remaining fish, a Brown Trout, was free from *Cystidicola,* and the swim-bladder showed no signs of inflammation, nor could any bacteria be detected."

"In each case, before opening the swim-bladder, the wall was well seared with a red hot seeker, a sterile platinum needle introduced, and sterile, sloped tubes of peptonised fish gelatine were inoculated. The tubes inoculated from the seven infected fish showed a free growth of bacterial colonies in the course of a few days, whilst the one inoculated from the remaining fish, which was free from *Cystidicola,* remained sterile. At least twelve different species of bacteria were present, distinguishable by their shape, form and colour of the colonies, powers of liquefying gelatine, staining reactions, etc."

"The gas from the swim-bladders of two of the infected trout was collected, and an analysis gave—

Carbon dioxide (absorbed by potash) 1.5%.
Oxygen (absorbed by potassium pyrogallate) 0.0%.
Nitrogen (by difference) 98.5%."

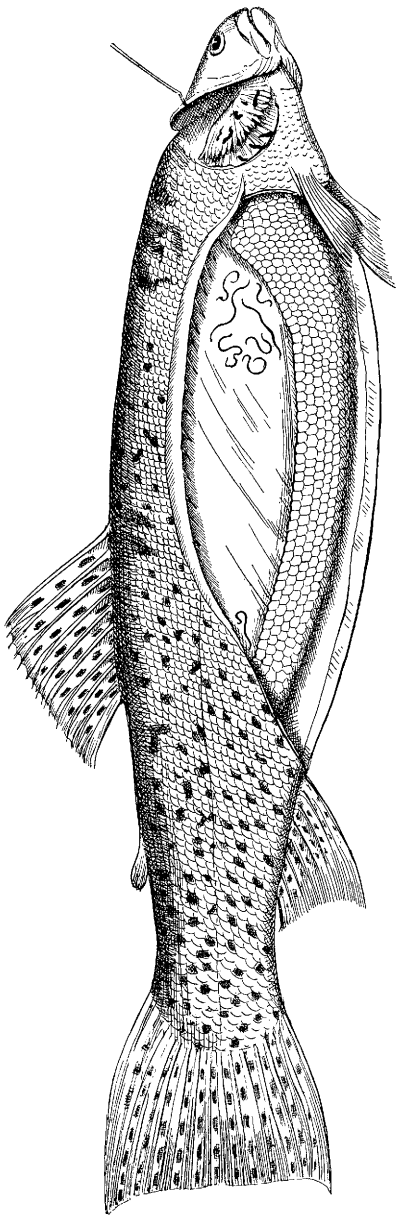

Fig. 1.—A rainbow trout, × ⅓, opened to show 7 specimens of *Trichostrongylus pergracilis* (Cobbold), in the anterior end of the swim-bladder and one in the posterior. The operculum is hooked up to show specimens of the Trematode, *Octohollirum sagittatum*, Lck., on the gills.

" These fish had been caught and allowed to die in the air, so it is possible that any oxygen present during life may have been used up during the process of asphyxiation. Mr. F. G. Richmond, of the Surrey Trout Farm and United Fisheries Co., Ltd., kindly sent me some healthy fish, uninfected with *Cystidicola,* for purposes of comparison; cultures from the swim-bladders of these fish in every case remained sterile. It would thus seem probable that bacterial infection may be conveyed by *Cystidicolae* in their migration into the swim-bladder of the trout, and it is possible that death may be caused by the introduction of pathogenic organisms in this manner. It is easily conceivable that any agent causing acute inflammation of the swim-bladder with the consequent dilatation of its blood-vessels, would produce excessive liberation of dissolved gases from the blood, and thus by undue distention of the swim-bladder disturb the equilibrium of the fish."

" With regard to the mode of entry of the parasite, it is possible, as Shipley (*loc. cit.*) suggests, that they enter along the ductus pneumaticus, but it is also possible that in some cases they migrate directly from the intestine. I recently examined a roach containing *Cystidicolae* both in the intestine and swim-bladder, in which the parasite could be seen in various stages of development encysted in the intestinal wall, mesentery, and subperitoneal tissue, and so apparently making its way from the intestine to the swim-bladder directly through the tissues."

It, however, now seems clear from this last observation that the Nematode enters the swim-bladder by piercing through the intestinal wall and traversing the intermediate tissues, and it seems certain that the numerous bacteria which are found in the air-bladder have been brought there by the migrating Nematodes. It is a clear case of bacterial disease arising from inoculation by a Nematode.

During the last three years I have been working on parasites of the grouse in connection with the Grouse Disease Enquiry. At times the grouse were very heavily infected both with Cestodes and with Nematodes, the former being found in the intestine, the latter both in the intestine and in the paired caeca. The grouse is remarkable amongst birds for the large size of these diverticula, the two together being at least as long as the whole of the rest of the alimentary tract. It would seem as if the whole of the absorption of the nutritive food takes place in these organs. Each caecum, in a badly infected bird, may contain thousands of the thread-worm *Trichostrongylus pergracilis* (Cobbold), and such heavy infection is accompanied by changes, inflammation, or an atrophy, in the thick-

ness of the caecal walls. Following on these changes is a decrease in the power of absorption. Now, we have found that the Nematode *T. pergracilis* winds its thin anterior end around the papillae on the inner surface, and may in this way interfere with the normal functions of the mucosa, but Dr. Leiper has also satisfied himself that the thin anterior end actually pierces the mucous lining of this part of the alimentary canal. By this breaking of the continuity of the mucous lining, the numerous bacteria which swarm in the lumen of the alimentary tract gain access to the deeper tissues. These bacteria are harmless whilst in the alimentary canal, but set up pathogenic change when they reach the deeper tissues, and Dr. Cobbett and Dr. Graham Smith have clearly shown that when the infection in the caeca of the grouse, caused by the presence of *T. pergracilis,* passes a certain limit, bacteria exist in large numbers in the liver, lungs, and other tissues of the body. Below this limit bacteria in these tissues are few and far between, and one must not forget that isolated bacteria occasionally make their way through the tissues without help from the grosser intestinal parasites. These are probably quickly absorbed, and it is only when their numbers are so large that the phagocytes and other protective cells are unable to cope with them that disease is set up.

Finally, we have the species of *Strongylus quadriradiatus*, recently described by E. C. Stevenson.[1] It occurred in considerable numbers in the intestines of a flock of fancy pigeons which had been almost destroyed by a malady of unknown origin early in 1904. In his article upon this epizootic, Stevenson points out that the presence of a few Nematodes in the caecum of the pigeon causes little harm. If, however, the thread-worms exist in large numbers, disease becomes manifest. This Stevenson attributes to two causes: the first is the loss of blood: but there is, I think, little or no evidence that these Nematodes live on blood. The second cause is the piercing of the walls of the intestine,[2] which permit the bacteria of the contents of the alimentary canal to make their way into the peritoneal cavity, where they set up peritonitis. Evidence is gradually accumulating as to the occurrence of this, and some of the French authorities even think that such a perforation, made as a rule by *Trichocephalus dispar,* is one of the more common, if not the most common, cause of appendicitis in man. The presence of these worms further sets

[1] U.S. Board of Agriculture, Bureau of Animal Industry, Circular XXXVII, 1904. This will probably prove to be a *Trichostrongylus*.

[2] An actual perforation of the membrane is not in all cases necessary. There are examples of bacteria traversing the wall or parts of the wall of the alimentary canal which have been locally or temporarily weakened in some way.

up an inflamed, catarrhal condition of the walls of the intestine, which leads to a debilitating diarrhœa, and to general disorders of the digestive system.

In Volume No I. of *Parasitology*, under the title "A Cause of Appendicitis and other Intestinal Lesions in Man," I drew attention to the numerous cases in which human parasites cause a discontinuity in the lining membranes of the various spaces of the body, and thus allow the access of the intestinal flora to the deeper tissues. The cases I recorded were taken from many sources, but the majority of them came from a paper by Weinberg, published in the *Annales de l'Institut Pasteur*. I regret to say I entirely overlooked a paper by Professor R. Blanchard, published in the *Archives de Parasitologie*, 1906, in which he forestalled to a great extent what I had to say, but I was happy to find, on reading his paper, that the conclusions which I have arrived at are very similar to those that this great master of Parasitology has put forth.

One interesting case quoted in my paper was that of infecting certain apes with typhoid bacilli. In some cases both Grünbaum and Soloukha had failed to give monkeys typhoid, but in the cases mentioned by Weinberg certain apes which were infested with Cestodes and also with *Trichocephalus* took the disease, the passage of the bacillus being apparently aided by the lesions in the intestinal wall caused by the burrowing of the heads of these creatures.

Weinberg[1] concludes his thesis by saying that his microscopic sections show that:—

(i.) The tape-worm, by fixing itself on the intestinal mucosa, or lining membrane of the intestine, sets up an intense congestion at the point of fixation;

(ii.) At the same time it makes such bacteria as are to be found on its suckers adhere to this point of the intestinal mucosa, and it further imprisons between its suckers and the intestinal wall such bacteria as existed before on this portion of the mucosa;

(iii.) A considerable number of leucocytes (white blood corpuscles) make their way to the surface of the mucosa and take up the bacteria;

(iv.) At other times, the bacteria penetrate into the thickness of the mucosa and set up inflammatory changes which may end in one of those ulcerations which are so often found at the point of fixation of the tape-worm.

It seems then that Weinberg does not allow that the Cestode head breaks the continuity of the mucosa. He does not give precise

[1] Ann. Instit. Pasteur, xxi, 1907, pp. 417 and 533.

details as to the species of "ténia" he is dealing with, and it may very well be that the unarmed species do not penetrate the lining of the intestinal wall. But whoever will study Piana's paper[1] will, I think, have little doubt that in such genera of tape-worm as *Davainea,* and I think we may add *Hymenolepis,* there is a distinct solution of the continuity of the lining mucosa of the host.

I am not sure quite how much injury to the mucosa is required to admit germs which are harmless within the gut lumen, but pathogenic when they gain free access to the blood or tissues, especially when the latter have been injured. Without doubt the passage of the bacteria which set up intestinal disease is immensely aided by any agent which causes a lesion in the mucosa. Such lesions are normally caused in man,—apart from any irritating substances he may swallow with his food, such, for instance, as the powdered diamond or glass which is said to have been used in Italy in the palmy days of poisoning—by entozoa.

It is sometimes urged that Chinamen, Abyssinians, and other foreigners whom Englishmen are apt to group together under the term "natives," and who are notoriously rich in entozoa, seldom suffer from appendicitis or peritonitis, but we must not forget the fact that some people and races are much more "tolerant" of all sorts of parasites, bacterial and others, and when infected, suffer far less than do others who are more susceptible to their action.

In my essay on "A Cause of Appendicitis," from which I am freely quoting, I confined my attention in the main to but three human intestinal parasites—*Oxyuris vermicularis* (Lin.), *Ascaris lumbricoides* (Lin.), and *Trichocephalus trichiurus* (Lin.)—all of them Nematodes. There are, however, many more which merit discussion, but these three are from my point of view the most important. Two of these, the *Oxyuris* and the *Trichocephalus,* are comparatively common, and the latter is probably much more common than is usually recognized. The family doctor knows how common *Oxyuris* is. Comparatively few children escape it, and it attacks the rich and the poor, the apparently well-cared-for and the neglected with complete indifference. A short time ago I found three specimens of *Oxyuris* in the extirpated appendix of a patient who was quite ignorant, as were her parents, that she harboured these worms.

Further I confined my attention largely to appendicitis; there are, however, many other diseases whose presence is associated with entozoa in the alimentary canal, *e.g.,* certain forms of diarrhœa; some

[1] Mem. Ac. Sci. Instit. Bologna, 4 Ser. II, p. 387.

of these have been described by Weinberg, who has investigated the relations of many more parasites to the intestinal wall than are considered here. All tell the same tale.

When one attempts to discuss the possible origin of appendicitis from entozoa with a surgeon or indeed with a pathologist, one is met with the reply that hundreds and thousands of appendices are removed annually and no parasite is seen in them. But are they carefully looked for and are they looked for by someone accustomed to see entozoa? How many medical men are acquainted with the appearance of even our commoner human parasites? It struck me as rather remarkable that one of my most promising pupils, who is entitled to place M.R.C.S., L.R.C.P., after his name, judging by a letter to the *British Medical Journal*,[1] should have referred so characteristic and so common a parasite as "*Trichocephalus dispar*" (= *Trichocephalus trichiurus* (Lin.)) to an expert before he was sure what it was he had found; but nowadays but few medical students are taught anything about entozoa. There is an extreme difficulty of seeing *Hymenolepis microps* and *Trichosoma longicolle* in the intestine of the grouse. Their complete transparency made them, when alive, invisible, and for years they have eluded the observation of the numerous competent observers who have dissected that much dissected bird. To some extent this is not true of the living *Trichocephalus*, a near ally to *Trichosoma*, but it is well known that the whip-worm conceals itself in the mucus, and is therefore easily overlooked unless very special care be taken in searching for it. Again, it is a well known fact that most entozoa move about, and the absence of *Trichocephalus* from an extirpated appendix is no proof that one or more may not have been there some time before the operation took place and have given rise to the inflammation and then have "gone on" as the saying is. Especially are they prone to shift their quarters after the death of their host, and this may well explain the difficulty of finding them in post-mortem examinations.

Since the discovery of bacteria and during the important work which has been done on the germ theory of disease during the last forty or fifty years, the grosser human parasites have been rather left in the shade. Before that time it was much more usual to administer vermifuges from time to time. Many of the numerous ailments of children were treated by our medical grandfathers with antihelminthics, and even to-day Sir Patrick Manson recommends that in the tropics and in other places where the intestinal parasites are common, a course of santonin should be administered to children

[1] Brit. Med. Journ., 1906, II, p. 364.

every six months. In spite of the great increase in our knowledge and practice of hygiene, personal cleanness, care in our meat supply, etc., which has so materially lessened the number of cases suffering for instance from the pork or beef tape-worm, I am not convinced that as regards other entozoa, whose entrance into the body is less easily controlled, we keep the inside of our digestive system as clean as our ancestors kept theirs. Our bodies may be but "whited sepulchres, which indeed appear beautiful outward, but are within full . . . of all uncleanness." Still times are changing, and increasing attention is being paid to what I am convinced is a serious factor in certain diseases. The matter is one which in England has received so far but little attention. Looking through the list of the "cloud of witnesses" given in my longer essay, hardly an Anglo-Saxon name occurs. Our knowledge of the relations of the parasite to the intestinal wall is derived mostly from Italian, French and German sources. In the United States, however, there is at least one voice "crying in the wilderness." Professor H. B. Ward[1] having carefully considered the entozoa as germ-carriers and germ-inoculators, says "there has prevailed during recent years among the medical men of this country an exaggerated idea of the unimportance of human parasites. This must now give way to a proper conception of the pathological significance of these organisms, based upon careful investigations of their actual influence upon the host."

Within a very few years the science of medicine has seen the greatest and most sudden advance—comparable only with the discovery of bacteria—which the world has yet witnessed. The discovery of the protozoal origin of many diseases is a factor in the hands of man which will enable him to repeople dark continents and to exploit the riches of the tropics. There is no more interesting chapter in the history of this discovery than that which teaches us of the part played by insignificant insects, gnats, mosquitos, fleas, bugs and biting-flies, and the still more obscure arachnids, ticks, in conveying the pathogenic organisms through the skin of man. No more valuable advice can be given to those exposed to diseases borne by these insects and by ticks than to keep a "whole skin." May not the entozoa in our digestive organs be playing a part similar to these biting and piercing ectozoa? We cannot keep off tape-worms with mosquito-netting, nor can we destroy threadworms' larvae with films of paraffin oil, but we can by the use of suitable medicaments drive

[1] "Studies from the Zoological Laboratory." The University of Nebraska, No. 69, 1907.

these entozoa out of the body, and by care in selecting and cooking both our food and water materially hinder the access of their larvae to the interior.

Entozoa are indeed much more deadly than the biting Arthropods, because whereas the biting-insect is by no means always infected, and when he (one ought in most cases to say she) is, the protozoa cause them at least as much illness as they cause man, the entozoa are at all times surrounded in the intestine by a constant supply of *B. coli,* and other germs capable of exerting a pathogenic action if they gain access to the deeper tissues.

Since the time when vermifuges practically ceased to be given appendicitis has become more and more common, and is now one of the most dreaded of human diseases in civilised countries. No satisfactory explanation of this has been as yet given. Bagshot somewhat cynically says: "It is a solemn fact that the discovery of a new disease immediately creates a demand for it," but appendicitis is too serious a matter for joking. Even when the appendix is removed and the patient recovered, do we know what we have removed? Because physiologists tell us they are unable to discover any function which the appendix performs it by no means follows that it has no functions. Some years ago they said much the same about the pineal gland, the suprarenal bodies and the pituitary body, but owing to recent research, "nous avons changé tout cela," as Sganarelle said about the position of the heart. I do not myself believe in an organ without some function, be it ever so insignificant. And I have never quite understood why the appendix veriformis should be regarded as a vanishing organ; we know too little about the ancestors of man to assert that this is so. If we go back sufficiently far to some "probably arboreal," vegetable-feeding ancestor, it may be true, but in that case the time which has elapsed would—unless it had acquired a new function—have induced it to disappear altogether like the tail or the general condition of hairiness. No, in my opinion, the theory of "Functionswechsel" is here at work, and there is a function for the appendix, and to quote Bagshot again, "it will now probably be discovered by the 'method of difference.'"

In reference to this matter I may quote from one of the last papers by Professor R. J. A. Berry and Mr. L. A. H. Lack, who have written so much on the appendix:—

"Lastly, in framing our conclusions, it must be borne in mind that such conclusions are not based solely on the appendix of man, but on what has already been worked out by one of us for the animal kingdom in conjunction with what we now find in the appendix

vermiformis of man. The conclusions which we draw from these investigations are as follows:—

"1. Lymphoid tissue is the characteristic feature of the true caecal apex throughout the animal kingdom, including man. As the vertebrate scale is ascended, this tissue tends to be collected together into a specially differentiated portion of the intestinal canal —the vermiform appendix."

"2. The amount of lymphoid tissue present at the caecal apex varies, most probably, though not certainly, in accordance with the varying diet of the animal."

"3. The vermiform appendix of man is not therefore either a vestigial remnant, or an organ in a state of retrogression, but is an actively functional lymph gland. It is no argument against this view to state that because the appendix is frequently removed without any apparent functional disturbance that it is useless, because the same argument might be adduced against the stomach, which is occasionally removed either wholly or in part, and with more or less success."

"4. The appendix of man is not equally functional throughout the whole of life. At birth it contains practically no lymphoid tissue; within six weeks it has become a lymph gland, and continues as such during the first half of life, after which it progressively declines in functional activity. Lymphoid tissue is therefore a tissue of the growing animal."

"5. Obliteration of the vermiform appendix is a pathological process."

"6. The functions of the human appendix are the same as those of any other collection of lymphoid tissue in any other part of the body."

Somewhat similar opinions are held by Professor Blanchard, and I am told that those intrepid extirpators, the surgeons of the United States, are beginning to consider that the removal of the appendix in children retards the growth of the patient.

I am not very sanguine that this address will have any effect. Doctors are most properly a conservative class; Englishmen, as Matthew Arnold pointed out, are somewhat impervious to new ideas. I cannot write with any more authority on medical subjects than that of a "registered medical student," but if it will in even a few cases lead to further enquiry it will repay me a hundredfold for the trouble —and pleasure—I had in writing it.

[1] Prof. Richard J. A. Berry and Mr. L. A. H. Lack, Journal of Anatomy and Physiology Vol. XL, p. 256.

NOTE ON THE BIOLOGY OF *PESTALOZZIA HARTIGII*, TUBEUF.

By

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Indian Forest Service.

With Plate VII.

History and Present Knowledge.

Pestalozzia hartigii is a fungus falling in the *Phragmosporae* section of the *Melanconieae,* a group of the Fungi Imperfecti, or Higher fungi, of which the conidial form alone is known.

It is recognised as the active agent of a seedling disease (*Einschnürungskrankheit*) of several timber trees in Europe. The evidence of its connection with the disease, however, is based entirely on the observation that it is always present when the constriction characteristic of the malady appears.

Before the relation between the parasite and the disease was established by von Tubeuf in 1888 (2), the cause of the latter was variously ascribed to frost, drought and similar agencies. Hartig, for instance, believed it to be due to compression by the mechanical action of freezing soil (1).

Both natural and nursery seedlings, one to five years old, of beech, ash, maple (3), spruce and silver fir (2), have been reported to be subject to attack.

The constriction invariably appears on the stem just above the level of the soil, and is due to the death of the cambium all round, whereas the tissues immediately above, and to a certain extent below as well, continue to grow till the death of the whole plant.

No connection between any species of *Pestalozzia* and any of the definite groups of the Higher fungi has yet been demonstrated, so that the genus still awaits final classification.

Life-History.

Methods.—The original cultures were started with conidia from spruce seedlings that had died of the disease, and which had been sent to Professor C. von Tubeuf from one of the Bavarian Forest Divisions.

[Journ. Econ. Biol., September, 1909, vol. iv, No. 3]

The cultures were first started on a jelly of meat and malt extract in Petri-dishes, and were subsequently inoculated on bread moistened with sterilised water.

The work was begun at Professor von Tubeuf's laboratory at Munich and continued at the Royal College of Science, South Kensington. Two cultures, one on bread and one on beech twigs, were brought over from Germany in Erlenmeyer flasks.

For observation of germination in hanging drops, water, prune juice and jellies of beer-wort and of meat and malt extract were employed.

In Petri-dishes a jelly of meat and malt extract formed the nutritive substance, and the more permanent cultures in flasks were on bread and on beech twigs.

Growth of Mycelium and Fructification.

In nature, on living plants, as a rule, no external mycelium is to be seen; the signs of its presence are confined to small black pustules, full of spores, on the surface of the bark at the stricture.

These spores, or rather conidia, are four-celled, with the cells in one row. The two central cells are dark brown and opaque, the end ones hyaline. The apex is provided with two to five long hyaline cilia (Pl. vii, figs. 1, 6, 8). There is a hyaline stalk of variable length. The hyaline parts collapse readily and the cilia are easily broken off, so that when mature the conidia often appear two-celled only, both cells being dark and opaque, with a small hyaline papilla at each extremity. In this condition the conidium is barrel-shaped, and was so described in the earlier text books.

In any of the nutritive media detailed above, the conidia germinated abundantly in less than eighteen hours. Normally, only one of the dark cells puts out a germ tube, but occasionally both germinate (Pl. vii, fig. 7). The germinating cell swells out to assume a spherical shape, and puts out a small process (Pl. vii, figs. 1, 7), which rapidly grows out as a colourless germ tube full of oil drops (Pl. vii, figs. 2, 3, 4, 6).

The germ tube soon forks and branches (figs. 5, 7, 10) to form an elaborate system of hyphae. On bread the mycelium extends over the surface as a white felting and penetrates throughout the substratum. On twigs the mycelium not only covered the surface, but spread out between the twigs in a sheet, binding them together and to the sides of the containing flask.

In all the cultures conidia identical with those already described were formed sooner or later. The earliest reproduction of conidia

occurred in fourteen days, but in some cases fructification was delayed up to forty days.

The conidia arise in pseudo-pycnidia, which are recognisable as small black dots scattered irregularly over the surface of the culture. From these exude large drops of an apparently black liquid, which, under the microscope, can be seen to contain dense masses of the conidia. These conidia were found to germinate as readily as those which yielded the parent cultures.

In some cases a very short germ tube was produced and a new conidium appeared very close to the original one (Pl. vii, fig. 8), but, generally, it was only after a considerable development of the hyphae that fructification set in.

In hanging drops the conidia sometimes grew out singly and remained solitary, but more often they were formed on a side branch, and a number of others would eventually appear on the same or adjacent hyphae to form clusters (Pl. vii, figs. 9, 10, 11, 12). In the hanging drops no approach to a pycnidium was constructed, but, no doubt, in the large cultures the clusters are sunk in the mycelium giving the semblance of pycnidia.

In one hanging drop culture a peculiar growth presented itself. The hyphae were more abundantly septate than usual, and apparently successive conidia were put forth. (Pl. vii, fig. 13).

At first the young conidia are undivided, eciliate and colourless, and later begin to darken and become opaque (Pl. vii, fig. 10). Presently a single median septum is formed, and at that stage the conidium is two-celled and brown. It is only after a further stage of development that the hyaline end cells and the cilia are produced. (Pl. vii, fig. 9).

No other reproductive organs of any kind were observed in any of the cultures.

Inoculation Experiments.

In order to ascertain the manner in which plants are infected in nature the following experiments were carried out:—

Seedlings, one to five years old, of the species detailed below, were planted in pots: Beech, hornbeam, ash, maple, oak, silver fir, spruce, Scotch pine, Weymouth pine, and larch.

Inoculations were made in the following ways:—

Conidia from the pure culture to be employed were first tested and found to germinate freely. They were then extracted in quantities from the culture, and immersed in a spraying-flask in sterilised water. After thorough mixing, a drop of the fluid was

placed under a 1-6in. objective, with a No. 2 eye-piece, and an average of twenty conidia were counted in the field of view.

1. An incision was made with a sterilised blade on the stem of the plants to be inoculated just above the soil, and two drops of the liquid were allowed to fall on the wound, which was then occluded with grafting wax.

2. A similar treatment was carried out on roots below the soil level. The wound was occluded and the soil replaced.

3. The whole of the plant above ground was sprayed with the water containing conidia in suspension, no intentional wound to the plant being inflicted.

4. A small wound was made on the roots, and the soil was watered with the conidia carrying water.

5. The soil was similarly watered, but without damaging the roots.

6. A cut was made on the stem close to the soil level, and conidia were conveyed to the wound direct from a pure culture. The wound was bound up with strips of bast sterilised in alcohol, the spirit being allowed to evaporate off first.

7. A twig was broken off and the exposed surface was smeared with conidia taken direct from a pure culture. The area so treated was bound up with sterilised bast.

8. Finally, sections from a beech twig in the pure culture already referred to were grafted on stems and twigs.

In all cases control plants were set aside for comparison.

Altogether fifty-six plants were inoculated on four occasions: On the 18th December, 1908; 8th January, 5th February, and 8th May, 1909.

In no case did infection result from the inoculation.

Discussion of Results.

It seems that conditions of the nature of which we have at present no knowledge must co-exist in order that infection may take place.

The first two experiments, those of the 18th December and 6th January, were effected on plants that had just been procured and potted, so that they were, in all probability, in a condition of lowered vitality and, therefore, should have been specially susceptible.

It is possible that the co-operation of other organisms is necessary to enable *P. hartigii* to actively attack its host plants. On examining the diseased spruce plants sent into the laboratory at

Munich, I found that several other fungi, including a Penicillium and a yeast, and Bacteria were also present.

It is possible, also, that the first three experiments were made at an unfavourable time of year, and it is desirable that further attempts be made during the summer months. Unfortunately, I am not in a position to continue the research.

The disease is of considerable importance, as serious losses are occasioned in nurseries. The death of up to 30 per cent. of the seedlings has been reported from some Forest Divisions in Germany through the agency of this pest. In the present state of our knowledge, however, no protective steps can be suggested beyond the maintenance of the best cultural conditions in the nursery, so as to ensure strong healthy plants.

The only remedy that can be recommended in the absence of fuller information is the prompt removal and burning of all infected plants.

SUMMARY.

I. The conidia of *Pestalozzia hartigii* germinate readily in water, prune juice, and a jelly of meat and malt extract, within eighteen hours.

II. The fungus can be grown on bread and on sterilised beech twigs.

III. Conidia were reproduced in these cultures in from fourteen to forty days.

IV. No other form of reproductive organs were obtained during eight months culture.

V. All attempts at artificial infection of living plants failed.

My best thanks are due to Professor C. von. Tubeuf for suggesting the investigation, and to Dr. E. Münch for valuable advice during the initial stages of the research.

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1. **R. Hartig.**—"Allgem. Forst-und Jagd-Zeitung," 1883.

2. **C. von. Tubeuf.**—"Beitraege zur Kenntniss der Baumkrankheiten," 1888, p. 40.

3. **C. von. Tubeuf.**—"Pflanzenkrankheiten," 1895, p. 510.

Also an article by the last named author in the "Forstl. Naturwissenschaftliche Zeitschrift," November, 1892, p. 436.

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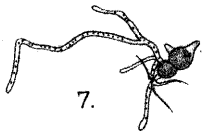

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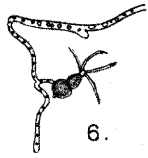

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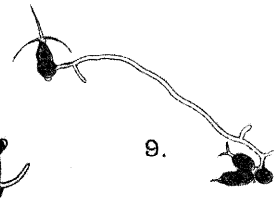

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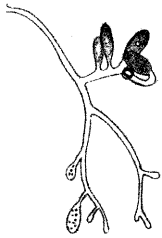

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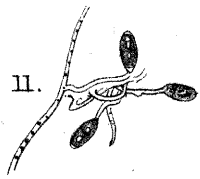

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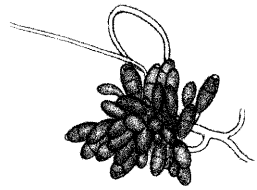

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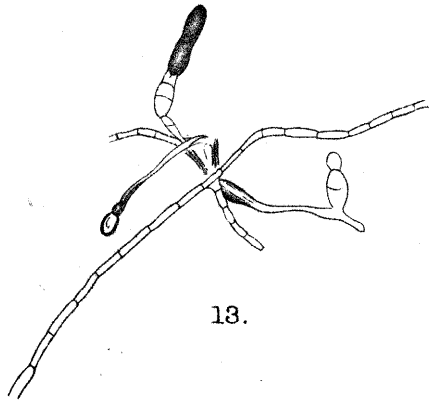

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PESTALOZZIA HARTIGII, Tubeuf.

EXPLANATION OF THE PLATE VII.

Illustrating Mr. Cecil E. C. Fischer's paper "On the Biology of *Pestalozzia hartigii*, Tubeuf.

All the figures were drawn with the help of the camera lucida.

Fig. 1.—Germinating conidium. × about 475.

Fig. 2.—Conidium with germ tube. × about 475.

Figs. 3, 4, 5, 6, 7.—Conidia with germ tubes. × about 250.

Fig. 8.—Short germ tube with new conidium formed near its parent conidium. × about 250.

Figs. 9, 10, 11, 12.—Progressive growth of conidia in clusters. × about 250.

Fig. 13.—Multi-septate hyphae producing successive conidia. × about 325.

Imperial College of Science,
South Kensington.
June, 1909.

THE BREEDING OF THE COMMON HOUSE FLY (*MUSCA DOMESTICA*) DURING THE WINTER MONTHS.[1]

By

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THIS short paper is merely an account of a few experiments which I was enabled to carry out at Cambridge at the commencement of this year on the breeding of the Common House Fly under artificial conditions:—

The remarks which it contains are for the most part a repetition of those which appeared in my report to the Local Government Board on this subject.[2]

The chief interest of the experiments is that they determine the duration of the various developmental stages of this insect under definitely controlled conditions of environment as regards food material and temperature, and that under favourable circumstances flies not only remain active, but actually continue to breed during the winter.

The problem as to how and where the common house fly spends the winter months is one which has not at any time ceased to puzzle entomological observers; for while it is well known that the fly disappears at the advent of the first frosts in late autumn, where it goes to and how it survives the winter in order to propagate the species in the following year, still remains more or less a mystery.

At the time when the cold weather commences, those flies which have not sought some protection against the severity of the weather are probably killed at once. Those, however, which have been more fortunate in securing the shelter of some place where the temperature is more suitable, such as a kitchen, restaurant, or bakehouse, continue to live an active life, and as will be seen later, actually continue to breed, providing that the conditions are favourable.

It is possible that some flies exist in a dormant state behind pictures and loose wall paper. Isolated specimens have been

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

[2] Reports to the Local Government Board on Public Health and Medical Subjects. New Series. No. 5. 1909.

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observed in a sluggish condition behind books in a bookshelf in December and January. These individuals were kept under observation, and a month later were still in the same positions and still alive.

Unhappily there was no further opportunity of keeping them under notice, but if they could exist through the winter to as late as the end of January in such places, there seems no reason why they should not live on until the spring and then continue to breed. The flies which one sees about at the close of the year are certainly more hardy and more tenacious of life than are those occurring in summer. This was a very noticeable feature in the experiments conducted at Cambridge in the Summer and Winter of last year.

A friend of mine states that upon the removal of an old window frame from his house during the winter, flies, which he believed to be specimens of *Musca domestica,* issued forth from the empty frame in very large numbers, but unfortunately there was no opportunity of examining these flies, and it is quite uncertain whether they were *Musca domestica.* This point is none the less interesting, however, as it indicates the type of winter quarters chosen by some flies which inhabit houses.

It has been suggested, I know not upon what authority, that flies may spend the winter in some one of the developmental stages, probably the pupa. The experiments conducted last winter at Cambridge do not confirm this view, as out of two hundred pupae raised from the eggs and kept at room temperature, not more than nine flies ever emerged, and they died almost at once.

Last February I accidentally discovered a large colony of flies in the sculleries and kitchens of one of the Colleges at Cambridge.

The flies were quite as active as in summer. The kitchens are underground, and the fires are kept up night and day throughout the winter. The temperature varied from 65° F. in the mornings to 80° in the evenings, and the flies though somewhat sluggish in the mornings became more active when the fires were stoked up.

It was decided to experiment with these flies to ascertain whether or not they would breed during the winter under favourable conditions. With this end in view about two hundred flies were captured and transferred to the Quick Laboratory.

By the kindness of Professor Nuttall, the use of a small greenhouse was secured, where a temperature corresponding to that of the kitchens was maintained, and it was in this greenhouse that the experiments were carried out.

Upon Dr. Nash's suggestion it was decided to adopt a method which he had found successful in his fly raising experiments. This

consisted in the detention of the flies in closed vessels with a food supply of moist bread, in which the process of fermentation had commenced. It was found on several occasions that the flies would not oviposit upon bread in which fermentation had not commenced.

For the experiments, ordinary lamp chimneys were used. These were all covered at one end with a piece of fine muslin, which was secured in its place by means of thread and melted paraffin wax. The flies—about a dozen of both sexes—were introduced into each chimney. The free ends of the chimneys were then packed with "bread-mash" and small pieces of newspaper, and inverted in a large tray of moist sand. The sand was moistened from time to time and so supplied the bread with moisture as and when required. In order to assist fermentation a small glass plate was placed on the ends of the chimneys to curtail the supply of air, but each day it was removed for a short while to allow of the admission of air to the flies.

After the flies had been confined for twenty-four hours they were observed to be ovipositing, and on the following day all the eggs had hatched.

The bread had by this time become very mouldy. It was noticed that the larvae displayed great dislike for the mould, as they took up positions as remote as possible from it, crawling up the sides of the chimneys to the places where air was being admitted.

The larvae were then transferred to a large glass tank, and over them was placed a thick slice of bread cut near the outer crust, and having the crust uppermost. The bread, which was stale, was slightly moistened, and the larvae then proceeded to feed. Over the top of the tank was stretched a piece of fine muslin, which was secured in its place by an elastic band, and over this was laid a plate of glass, leaving just a small space to allow of the admission of air. Scattered around the bread were several pieces of newspaper, under which the larvae eventually pupated. Where this method was employed, it was found that the larvae rarely left their feeding ground until they were fully fed, when they left the moist mass of bread for the surrounding dry area, and there pupated beneath the pieces of newspaper.

At a temperature ranging between 65° F. to 75° F. the complete development from the time of oviposition took three weeks.

The times for the various developmental stages were as follows:—

The Egg.—As soon as fermentation had commenced, the female flies began to oviposit, having previously selected as a suitable spot for oviposition, some place underneath the mass of bread. The

eggs, which were 0.5 mm. in length, and 0.15 mm. in breadth, were deposited in bundles of about fifty.

In twenty-four hours all the eggs had hatched.

The Larva.—The young larvae began to feed soon after emerging from the eggs, and commenced to grow rapidly, and after a period of thirty-six hours underwent their first moult. Having cast their skins the larvae continued to grow, and after four days the second ecdysis or moulting took place.

The larvae in the third instar, the last larval stage, grew very rapidly, and after a further period of five and a half days, left the food mass for the drier surrounding area and commenced pupation. This process lasted about six hours on an average. It commenced by a shrinking of the skin, and a gradual change in colour from a creamy white to a light brown. Later this light brown colour gave place to a darker brown. The whole larval period occupied eleven days.

The Pupa.—The time which elapsed before the emergence of the adult fly varied considerably. At 70° F. the longest period was eighteen days, but the average period was ten days. A few pupae placed in an incubator at 77° F. gave rise to the flies as early as the third day.

Several pupae placed in the kitchens where the flies were originally captured, did not give rise to the flies for eleven days. As above stated, the temperature of these kitchens corresponded approximately with that of the greenhouse where the experiments were carried out.

About two hundred pupae were kept at the room temperature of the Laboratory, but of this number only nine flies ever emerged, nearly four weeks elapsing before they did so, and they all died shortly afterwards. It appears from these figures that the pupae will not give rise to adults unless the temperature is favourable.

If such is the case it is improbable that flies spend the winter in the pupal stage as has been suggested.

The Adult.—Upon the emergence of the adults, they were all transferred to a large net cage, with the object of determining the length of life of the flies. They were successfully kept alive for eleven and a half weeks. The original flies caught in the kitchens were kept in captivity for ten weeks. How long they had lived before they were captured is of course unknown.

In the summer of last year in no case were the flies kept alive for more than three weeks, and then only in the case of a few individuals.

It appears therefore that the flies occurring at winter time are either more hardy or else more long-lived than the summer broods.

During the Easter vacation of this year the kitchen fires were allowed to go out for three weeks, causing a considerable fall of temperature. Upon visiting the kitchens at the end of this period, not a single fly was to be seen. It was five weeks before a fly was again seen there, and up to the time of writing (June, 1909), there have not at any time been more than about a dozen flies.

Conclusions.

The following conclusions are taken from my report to the Local Government Board, and are based upon the foregoing experiments:—

1. Flies do not disappear altogether during the winter as popularly thought, but may be found in places where the temperature conditions, etc., are favourable.

Whether under such circumstances they ordinarily continue to breed as in the warmer months cannot be said, but that they *will* breed in the winter, provided that the necessary conditions are present, is evident from the foregoing experiments.

2. The fact that the flies have been seen in coitû in great numbers, seems to favour the view that they may breed in these warm places in the winter, assuming that their breeding places remained undisturbed during the larval stage.

3. On the other hand, the fact that flies taken at this time of the year appear more hardy and long lived, than those taken and kept under the same conditions in the summer, seems to support the view that the former may persist throughout the winter as adults.

4. If, as seems probable, flies are only to be found in winter in isolated colonies in certain warm places, the possibility of an appreciable reduction in their numbers, or even perhaps of their extermination, may become somewhat more hopeful. In such places they could easily be destroyed, as even the slightest exposure during the cold months is fatal to them. This is seen to advantage in the above case, where the fall in temperature, occasioned by the putting out of the fires for the Easter vacation caused the complete disappearance of the flies for a period of five weeks.

THE RÔLE OF COLLEMBOLA IN ECONOMIC ENTOMOLOGY.[1]

By

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With 1 Figure.

Amongst the many points of interest presented to the zoologist by the Order Collembola, not the least is that of their economic importance.

It is only within comparatively recent years that they have been regarded as injurious insects, and even now they are generally held to be not the primary cause of injury.

In 1905 Professor Carpenter[2] called the attention of economic biologists to this Order, and instanced cases of direct damage to the roots and seeds of healthy plants, since that date large quantities of materials have passed through my hands and numerous experiments have been made, with the result that one is forced to the conclusion that these tiny insects are not unfrequently the primary and only cause of injury to certain plants, and that they also play an important part in exposing different plants to the attacks of fungi by the injury they cause in wounding their surface.

The number of British species has been estimated by Carpenter and Evans[3] at about 75, but more recent investigations have raised this number to over one hundred, and there are probably many others awaiting discovery.

The references in the literature are comparatively few. Curtis[4] mentions a species of *Sminthurus* as feeding upon the parenchyma of the green leaves of the potato, and states: "In Novia Scotia the crops of turnips and cabbages are principally destroyed, whilst in the seed leaf, by some *Sminthurus,* the size of a pin's head, and nearly globular. It hops with great facility by means of its forked tail, and may be found on every square inch of all cultivated land, but it is not plentiful on new land." He also alludes to a *Podura*

[1] Read before the Association of Economic Biologists, Oxford Meeting, July 13th, 1909.

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

[3] Proc. Roy. Phys. Soc. Edinb., 1899, vol. xiv, p. 224.

[4] Farm Insects, p. 432.

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(*P. plumbea,* Linn.) being abundant in February, 1846, skipping about the rotting potatoes.

Murray[1] speaks of young gherkins being "stripped of great portions of their skin, that have been browsed or rasped away by these little creatures." He also refers to the damage they do to succulent roots and plants, especially where anything has happened to diminish the vitality of the plant.

Miss Ormerod[2] records injury to the leaves of turnips by *Sminthurus luteus.*

Guthrie[3] states that he learned from Professor H. E. Summers, State Entomologist of Iowa, that a species, probably belonging to the genus *Achorutes,* was so abundant in the soil containing seeds, and kept it so thoroughly worked up, as to give the little plants no chance to root, and that many died.

A very similar case has come under my own notice, when a large bed of sweet peas was completely destroyed by *Achorutes armatus* (Nic.). As soon as ever the seeds commenced to root the soil was moved by the movements of these tiny insects, and ultimately, when about three inches high, the plants fell over and died.

Carpenter[4] has also recorded this species, *A. longispinus,* Tullb., and *Lipura ambulans,* Linn., damaging bean seeds. This latter species frequently causes extensive damage to bulbs. I have recorded a case from nursery gardens, Birmingham, where Narcissus bulbs were attacked by this species, and *Achorutes armatus.*[5] A further case has recently been brought to my notice where a large house of bulbs were rendered completely unfit for sale owing to an attack of *L. ambulans.* This same species is frequently found attacking the roots of cruciferous plants.

Mr. Theobald[6] records a species of *Orchesella* and other Collembola attacking orchids; also *Entomobrya nivalis,* Linn.,[7] as causing considerable damage to hops. The attack was noticed about the middle of July, when the burr was being rapidly cleared off and the bine was also damaged where tender. The damage seemed to be mostly done at night, the insects sheltering under clods of earth during the day time.

Still a further case is recorded by the same writer, viz., a species

[1] Economic Entomology, Aptera, p. 404.
[2] Rpt. Obs. Inj. Insects for 1904, p. 110.
[3] The Collembola of Minnesota, 1903, p. 4.
[4] Proc. Assoc. Econ. Biol., 1905, vol. i, p. 14.
[5] Rpt. on Inj. Insects for 1905, p. 10.
[6] First and Second Rpt. Econ. Zool., 1903, p. 110, 1904, p. 75.
[7] Rpt. Econ. Zool. for 1908, p. 100.

of *Isotoma* as being a great torment to fowls, being found in old and foul nests.[1]

Marlatt[2] has recorded a species of *Lepidocyrtus* as infesting houses in the United States.

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

Fig. 1.—Piece of Stem of Zinnia, showing damage due to Springtails.

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.

[1] Paras. Dis. Poultry, 1896, p. 37.

[2] Canad. Entom., 1896, vol. 28.

The specimen of Zinnia shown in Fig. 1 will well illustrate the serious nature of the damage these insects sometimes do.

Amongst the bulbs the Hyacinth, Narcissus, and Tulip have perhaps been the worst sufferers. The nature of the injury is practically the same in all cases, and consists in scraping away the epidermis and then the softer tissue until a distinct hole or depression is formed. After this stage, decomposition of the plant tissues rapidly takes place, due to the inroads of fungi, and the bulb is practically ruined.

A list of the species which are distinctly injurious is appended herewith, but in all probability all Collembola are more or less injurious to plant life. I should be very pleased to receive particulars of, or plants damaged by other species.

*__Lipura armata,__ Tullb.
__Lipura ambulans__ (Linn.) Tullb.
__Lipura burmeisteri,__ Lubb.
__Lipura fimetaria__ (Nic.) Lubb.
__Achorutes armatus__ (Nic.)
__Achorutes manubrialis__ (Tullb.)
__Anurida granaria__ (Nic.)
__Isotoma palustris__ (Müll.)
__Orchesella cincta__ (Linn.)
__Entombrya nivalis__ (Linn.)
__Entomobrya multifasciata__ (Tullb.)
__Lepidocyrtus__
__Sminthurus fuscus__ (Linn.)

* I use the generic term *Lipura* as that of *Onychiurus*, Gerv., might be misleading in a paper of this kind.

NOTES ON SOME COLLEMBOLA NEW TO GREAT BRITAIN.

By

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AND

JOHN W. SHOEBOTHAM, N.D.A.

FOR some time past we have been investigating the Collembolan fauna of the County of Hertfordshire, with the result that we have a very formidable list before us of these minute but deeply interesting insects.

Our work is yet far from complete, but we think certain of the species we have obtained are of sufficient interest to warrant their being placed on record.

All the species here recorded have been found in Hertfordshire, in fact all have been taken within one mile of Berkhamsted. It is interesting to observe that in several of the new species recorded there are less than the normal number of eyes.

Family PODURIDAE, Lubb., C.B.

Genus **Pseudachorutes**, Tullb.

It gives us great pleasure to be able to record this genus for Great Britain. The general shape of the body is that of a somewhat short *Achorutes*. Mouth, suctorial. Antennae, conical. Eyes 16, eight on each side of the head. Anal horns and lower claw (empodialanhang) absent.

The species of this genus seem to prefer to live under the bark of moist rotting wood. This is what we would expect when we consider the suctorial mouth.

We have two species, but one we have not identified with any described form yet.

Pseudachorutes subcrassus, Tullb.

Tullberg, Förteckning öfver Svenska Podurider, 1871, p. 155.

This is the type species on which the genus was founded. The post-antennal organ has 10 tubercles arranged in a ring. Tibia without tenent hair. Colour, light greyish blue, lighter underneath.

Hab.—Near Berkhamsted, Herts., under bark of rotting wood.

Genus **Achorutes,** Templ.

Achorutes neglectus, Börner.

Börner, Apterygoten-Fauna von Bremen und der Nachbardistrikte, 1901, p. 30.

This species has short and scanty hairs on the body, rather more on abdomen V. and VI. Upper claw with one inner tooth, lower claw bristle-like in this respect resembling *A. manubrialis,* Tullb. Tibia with one tenent hair. Anal horns absent. Dens twice as long as the mucro. Colour, dark grey-blue, pigment mottled, underside lighter.

Hab.—Berkhamsted, Herts., amongst short grass, and on a puddle of water, evidently washed by rain from the above.

Family ENTOMOBRYIDAE, D.T.

Genus **Isotoma,** Bourl.

Isotoma binoculata, Wahlgr.

This species seems to be intermediate between the blind *I. fimetaria* (Linn.), Tullb., and the species *I. quadrioculata,* Tullb.

The single eye on each side of the head is in the position of the anterior one of *I. quadrioculata,* Tullb. It is whitish in colour, with a little greyish pigment, except for the eyes, which are black. We have only one specimen.

Hab.—Berkhamsted, Herts., under a flower pot in a greenhouse.

Isotoma minor, Schäff.

Schäffer, Collembola der Umgebung von Hamburg und benachbarter Gebiete, 1896, p. 182.

We have found a few specimens of this species in several situations around Berkhamsted, such as under sticks in a wood, under flower pots in a greenhouse, and one specimen we found under a stone along with *Neelus murinus,* Folsom.

It may be distinguished from *I. fimetaria* (Linn.), Tullb., which it at first sight somewhat resembles, by the presence of feathery setae on the abdominal segments, and six or seven peculiar sensory hairs (smelling hairs? of Börner) on the fourth antennal segment. It has three teeth on the rather short mucro instead of two on the more elongated one of *I. fimetaria.* Moreover, *I. fimetaria* has a post-antennal organ which is absent in *I. minor.*

The claws are without teeth. Colour very light grey, in alcohol white.

Hab.—Berkhamsted, Herts.

Genus **Sinella,** Brook.

Sinella höfti, Schäff.

Schäffer, Collembola der Umgebung von Hamburg und benachbarter Gebiete, 1896, p. 192.

This white, blind species we have found running about very actively inside flower pots in a greenhouse, along with *S. curviseta,* Brook, from which it may be distinguished by the absence of eyes, and the mucrones having only one tooth. Dr. Börner figures a tenent hair in his drawing of the foot, but in all the specimens we have examined we cannot find that the hair is thickened at the end. It is significant that Schäffer describes as one of the characters of the genus, the absence of a tenent hair on the tibia.

The lower claw has a broad lamella on its outer side, reaching half its length, reminding one of the lower claw of *Cyphoderus albinos,* Nic.

Hab.—Berkhamsted, Herts., in greenhouse and under stones in the Castle Grounds.

Genus **Lepidocyrtus,** Bourl.

Lepidocyrtus sexoculatus, Guthrie.

Guthrie, The Collembola of Minnesota, 1903, p. 186.

We have one specimen which we believe came from under sticks in the Castle Grounds, Berkhamsted. It may be known from all other British species of *Lepidocyrtus* by the presence of two black eyespots on each side, the anterior one having two ocelli and the posterior one a single ocellus. We are not aware of its having been found in Europe before.

Hab.—Berkhamsted, Herts.

Genus **Pseudosinella,** Schäffer.

Pseudosinella alba (Pack.), Schäff.

Schäffer, Ueber württembergische Collembola, 1900, p 269

Lepidocyrtus albus, Packard, 1873.
Tullbergia ocellata, Lie-Pettersen, 1896.
Pettersenia ocellata, (Lie-Pettersen), 1898.

Like *Sinella curviseta,* Brook, it has two eyes on each side of the head, but the arrangements are different. In *S. curviseta* the two eyes are behind one another on two separate spots, whilst in *P. alba,* the two eyes are close together in one dark spot and arranged transversely.

There is a non-clavate hair in the place of a tenent hair.

Hab.—Berkhamsted, Herts., under sticks lying on the ground, in loose soil, and amongst decaying leaves.

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ON THE ANATOMY AND LIFE-HISTORY OF *RHABDITIS BRASSICAE*, N.SP.

By

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With Plate VIII.

In November, 1908, I received through Mr. J. Adams, M.A., of the Royal College of Science, Dublin, a turnip which was in an advanced state of decomposition, and was infested with vast numbers of minute Nematode worms. The turnip was sent from Co. Westmeath. It is with the structure and life-history of this worm that the present paper deals.

These Nematode worms belong to the family *Anguillulidae,* popularly spoken of as "eel-worms." They are extremely common in water, soil, and decaying organic matter. In the case of a few well-investigated species, such as *Heterodera schachtii,* Schmidt, causing "beet-sickness," *Tylenchus tritici,* Need., causing "ear-cockles" in corn, *Tylenchus devastatrix,* Kühn, etc., it has been placed beyond doubt that they are the cause of serious diseases in plants. In the majority of the cases, however, where these worms are found in considerable numbers in diseased plants, it is doubtful whether the eel-worms originate the disease or merely take advantage of a weakened condition of the plant. Such genera as *Tylenchus, Heterodera, Dorylaimus,* etc., are provided with a sharp spine, by means of which the epidermis of the plant can be pierced and its juices sucked. Even in such cases, however, the matter is frequently complicated by the presence of parasitic fungi, which may be responsible for the origin of the disease.[1]

In other genera, such as *Rhabditis, Plectus,* etc., this piercing apparatus is absent, and the power of these worms to originate disease in plants is not so obvious. Once the epidermis of the plant is pierced, the powerful sucking pharynx, with which these worms are provided, enables them to feed on its juices. When they are

[1] Board of Agriculture, Leaflet No. 46. "The Stem Eelworm *(Tylenchus devastatrix, Kühn).*" 1898, page 2.

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found in large numbers in a plant, the latter is usually in an advanced state of decomposition. Extensive observation and experiment in the field is necessary before one can state definitely whether these worms are a primary cause or only a symptom of disease.

The species I am about to describe is apparently new to science, and I propose to name it

Rhabditis brassicae, n.sp.

The genus *Rhabditis* contains about fifty species. Many of these are very insufficiently described and figured, and in some cases only the female is known. The females do not show such good specific characters as the males, and their identification is very difficult and unsatisfactory.

The members of this genus show great differences in their mode of life, and sexual relations. Some are parasitic in animals, some live in damp earth, or water, and others in decaying substances. They may be hermaphrodite, or of different sexes. In *R. brassicae* both sexes are found in approximately equal numbers. The female is 1-1.15 mm. long, the male .9-1.05 mm. The relative proportions of the oesophagus, tail, width of body, etc., are usually expressed as percentages of the length. In the following table similar measurements are given for a larval form, without genital organs. The width of the female is taken through a specimen with well-developed eggs.

	Male.	Female.	Inimature form.
Total length of body ...	1 05 mm.	1·15 mm.	·71 mm.
Oesophagus ...	·2 = 19%	235 = 20·4%	·165 = 23·2%
Buccal cavity ...	·025 = $\frac{1}{8}$ of oesophagus	—	—
Tail	·075 = 7·1%	·155 = 13·5%	·125 = 17·6%
Width	·05 = 4·76%	·07 = 6·1%	·031 = 4·5%
Vulva of ♀ ...	—	·63 from anterior end, = 55%.	—

The cuticle is smooth and without setae. The mouth is bounded by six low lips, each bearing a very small papilla (Pl. viii, fig. i). The buccal cavity is long and narrow, and at its base the lumen narrows rapidly. The anterior bulb is placed in the middle of the oesophagus, and is very muscular. The posterior bulb is almost spherical, and possesses the usual valvular apparatus. Midway between the bulbs is the nerve cord (Pl. viii, fig. 1, *n*). In the female the tail is long and filiform. There are several caudal glands behind the anus. The vulva is situated just behind the middle of the body.

The ovary extends three-quarters of the way to the anus and four-fifths or more of the way to the oesophagus. Each branch then runs back almost to the level of the vulva, and is then folded back once more (Pl. viii, fig. 3). In the mature female the vulva is somewhat prominent, and the vagina conspicuous. The uterus is large, and each branch may contain as many as fifteen fertilised eggs in various stages of development up to the morula stage. On many occasions I saw larval forms moving about freely within the body of the female, and there is no doubt that all transition stages between oviparity and viviparity are shown, though the latter is rare, and depends on circumstances which I failed to ascertain. I observed larval worms feeding on the internal organs of the female till only the cuticle remained, as described by Maupas[1] (p. 483) for *R. elegans*. I also saw eggs with 12 blastomeres being extruded. The eggs are always more or less segmented before extrusion.

Following the uterus is a chamber containing spermatozoa (Pl. viii, fig. 3, *s.r.*). The latter are developed in the genital gland before the ova mature. This species thus resembles several other members of the genus in that the females function as self-fertilising protandrous hermaphrodites. This phenomenon was first observed by Schneider[2] and thoroughly investigated recently by Maupas (*tom. cit.*) in a very interesting and able paper. In some cases spermatozoa could not be seen, and the cavity—known as the seminal receptacle—was empty. The sperm had probably been used up in fertilising the first eggs. The genital gland, for some distance beyond the seminal receptacle, is occupied with large ova, laden with yolk. The ova gradually decrease in size towards the free end of the genital gland. The ova, as they mature, pass through the seminal receptacle into the uterus, and during this passage, according to Maupas (*tom. cit.*, p. 585) each is fertilised by one of the spermatozoa. When the latter are all used up, the ova that follow are sterile, and do not develop.

In the males, the tail is long and filiform (Figs. 4 and 5). There are several small caudal glands (Fig. 5). Behind the anus, the body is conical, and terminates in a bifid tip (fig. 4 *b*) from between the minute lobes of which the filiform tail originates. The bursa is well developed, and extends some distance along the tail. It is provided with nine pairs of papillae, which are placed at regular intervals, the distances between them diminishing towards the tail. Six of

[1] E. Maupas "Modes et formes de reproduction des Nématodes." Archiv. Zool. Exp. et gén., 1900, T. 8, p 463.

[2] A. Schneider. Zeitschrift für wiss. Zool., 1860, T x p. 178. Also in *Monographie der Nematoden, 1866, p. 315.*

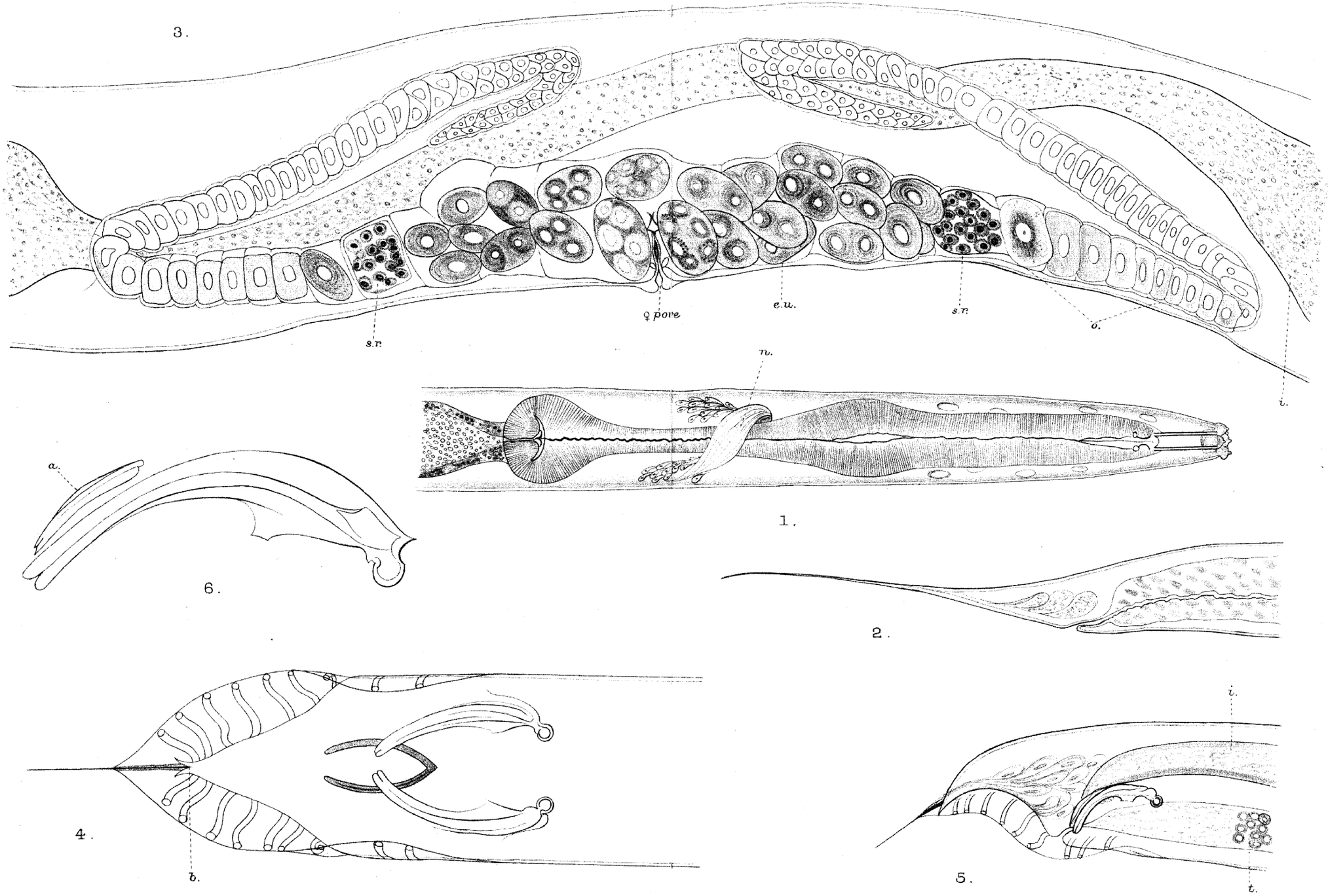
these papillae are below the anus (fig. 5), one is opposite the posterior end of the accessory pieces, one level with the posterior end of the spicules, and one is opposite the middle of the latter. The testis is very large, and after extending almost to the oesophagus, it curves back for a short distance. The spicules (figs. 4-6) are stout and curved. The proximal end is knob-shaped, whilst the distal end is distinctly bifid, thus resembling *R. duthiersi,* Maupas, to which it has a close general resemblance. The accessory pieces are slender and curved. They are connected at the end farthest from the male pore (fig. 4).

This species bears a very close resemblance anatomically to *R. aspera,* Bütschli,[1] from which species it differs in size, relative proportions, spicules, etc., but chiefly in the structure of the genital organs of the female, *R. aspera* being dioecious. From *R. duthiersi,* Maupas (*tom. cit.,* p. 513), it is distinguished by its smaller size, the shape of the tail in both sexes, greater size of the genital glands, and in the male by the different arrangement of the glands on the bursa, the different shape of the spicules, etc. In the female the uterus is larger and contains more eggs.

In all the hermaphrodite species of this genus so far described, the males are either unknown, or very rarely met with. Maupas (*Tom. cit.,* p. 588) who investigated this point, states that the proportion of males to females varies from 45 to 1,000 in *R. viguieri,* to .15 to 1,000 in *R. guignardi.* In *R. duthiersi* the proportion is 20 to 1,000. We see here a change from a dioecious to a hermaphrodite mode of reproduction, which in some species is almost complete, and no males are produced. Even in those cases where a small number of males is produced, it seems probable from Maupas' researches that the males have quite lost the sexual instinct, and play little or no part in the sexual process.

In the proportion of males and females, *R. brassicae* differs greatly from all the known protandrous hermaphrodites. The numbers varied greatly in several cultures which I made and counted, but the males are quite as common as the females. In one case there were 15 males to 22 females, in another 44 males to 12 females. I obtained no evidence that the males play any part in the sexual process. It is interesting to note that Maupas (*tom. cit.,* p. 588) ventured to predict the occurrence of a protándrous hermaphrodite in which the numbers of males and females would be fairly equal. In the proportion of the sexes, then, *R. brassicae*

[1] O. Bütschli. Beiträge zur Kenntniss der freilebenden Nematoden. Nova Acta der Ksl. Leop.—Carol deutschen Akad. der Naturf. Bd. xxxvi. Nr. 5. p. 113. 1873.



R.S. del.

Huth, sc. et imp.

RHABDITIS BRASSICAE, n. sp.

closely resembles the dioecious species, and probably represents one of the earliest stages in the transformation from the dioecious to the hermaphrodite condition.

I made some experiments on turnips with these worms, in order to ascertain if possible whether they could originate disease. When placed in contact with a cut surface, they quickly reduced the turnip to a pulp, and finally nothing was left but a little fibre and a large quantity of water. The worms reproduce and increase in numbers with excessive rapidity. Attempts to inoculate a turnip through the uninjured epidermis, however, quite failed. In one case, the worms were repeatedly placed on the surface of the turnip in large numbers, and kept in a damp dark chamber for a month, and at the end of that time the turnip appeared none the worse, and the epidermis was quite sound. The evidence thus goes to show that this species—and probably the others belonging to this genus, which are found in decaying vegetable matter—cannot originate disease, but that if they can gain access to the soft tissues, through injury to the epidermis, they will quickly destroy the plants.

DESCRIPTION OF PLATE VIII.

Illustrating Mr. Rowland Southern's paper "On the Anatomy and Life-history of *Rhabditis brassicae*, n.sp."

All the figures are drawn with the aid of an eye-piece micrometer.

Fig. 1.—Male, anterior end.

Fig. 2.—Female, tail.

Fig. 3.—Female, showing arrangement of hermaphrodite glands. *i.* intestine. *e.u.* eggs in uterus. *o.* ova maturing by addition of yolk. *s r.* seminal receptacle.

Fig. 4.—Male, posterior end, ventral view. *b.* bifid termination of the trunk.

Fig. 5.—Male, posterior end, side view. *i.* intestine. *t.* vas deferens.

Fig. 6.—Male, spicules. *a.* accessory piece.

NOTE ON THE INFESTATION OF A COCCID BY CHALCID PARASITES.

By

E. ERNEST GREEN,

Government Entomologist, Ceylon.

THE following facts may be worthy of record, as bearing upon the value of the importation of parasites to combat insect pests—a principle that I consider to have been greatly overstrained.

In the course of my study of a collection of *Coccidae* received from the Indian Museum, I had occasion to make a preparation of a single example of *Icerya aegyptiaca*. After boiling the insect in caustic potash, the liquor was found to be full of minute Chalcid wasps (still enclosed in the nymphal membrane) that had escaped from its ruptured body: and many more examples of the same Chalcid were still entangled within the tissues of the Coccid. Before making a count, I had unfortunately changed the liquid, so that many of the minute wasps were lost. But I estimate that there must have been at the very least one hundred parasites bred inside this single Coccid. Yet, in spite of such an army feeding at its expense, the body of the host also contained numerous well-developed embryos, and there were remains of an ovisac that had presumably contained many more ova. It is evident, from these facts, that even such complete infestation as here noted, is insufficient to prevent the productiveness of this particular pest.

Peradeniya, 24th June, 1909.

[JOURN. ECON. BIOL., September, 1909, vol. iv, No. 3]

REVIEWS.

Guénaux, G.—Entomologie et Parasitologie Agricoles. Pp. xii + 528, 413 figs. 2nd ed. Paris: J. B. Baillière et Fils, 1909. Price 5 fr.

We welcome a second edition of M. Guénaux's handy little volume, which is full of valuable information.

It is concisely written, well illustrated, and is one of the best volumes in the Encyclopédie Agricole, of which it forms a part.

Harmer, S. F., and Shipley, A. E.—The Cambridge Natural History. Vol. iv. Pp. xviii + 566, 287 figs. London: Macmillan and Co., Ltd., 1909. Price 17s. net.

The appearance of volume iv completes the ten volumes of this work. The subjects treated of are as follows: Crustacea, by Geoffrey Smith and the late W. F. R. Weldon; Trilobites and Eurypterida, by Henry Woods; introduction to Arachnida and King Crabs; Tardigrada, and Pentastomida, by A. E. Shipley; Scorpions, Spiders, Mites, Ticks, etc., by Cecil Warburton; and Pycnogonida, by D'Arcy W. Thompson.

The names of the authors are a sufficient guarantee of the thoroughness with which all the sections are treated; especial mention, however, must be made of Mr. Shipley's articles on the Tardigrada and Pentastomida.

The chapter on the general organisation of the Crustacea, as also that by the late Prof. Weldon, are excellent, but many of the Orders and sub-Orders in the later chapters are very briefly treated of. We especially note the absence of any reference to Groom's work on the Cirripedia, Canon Norman's on various Orders, and other leading investigators.

Chapters xii—xvii, treating of the Arachnida, supply a want long felt, and Mr. Warburton is to be heartily congratulated upon the remarkably full and valuable account he has given. The twenty pages devoted in chapter xviii to the Mites and Ticks, are most disappointing. The author has neither been able to do justice to himself or his subject.

In conclusion we congratulate the editors on the completion of their task. Certain volumes stand out as of conspicuous merit, and throughout them all, most of the articles are of a high order of merit, and have already proved of great value to students of zoology, whilst the illustrations have not been surpassed in any previously issued work of a similar nature.

W. E. C.

Lankester, Ray.—A Treatise on Zoology, Pt. IX, Vertebrata Ceraniata. (First Fascile: Cyclostomes and Fishes). By E. S. Goodrich. Pp. xvi + 518, 515 figs. London: Adam and Charles Black, 1909. Price 15s. net.

In calling attention to this splendid piece of work we cannot refrain from mentioning the fact that students of fish morphology have at last a text-book leaving little to be desired, and one in which the author is not ashamed to acknowledge the source of his information.

It would be invidious to compare the different volumes of this great work, but we cannot help remarking that this one fully maintains, if not exceeds, the high standard laid down by previous authors.

We welcome at last a rational system of classification, in which the old divisions of Ganoidea and Teleostei have disappeared. We are rather surprised to find an entire absence of any reference to the suprarenal organs of fishes or cyclostomes. All other systems are carefully and thoroughly described and excellently illustrated. It is pleasing to note an absence of many of the old figures which have done duty for so long.

In the useful Bibliography we note that there is no reference to the classical researches of Prof. W. C. M'Intosh, or to the writings of Dr. Gaskell, although the latter is mentioned in the text.

Hitherto we have had no work of recent date on fishes that could be regarded in any sense as authoritative, the original work of the author of this volume, together with that of numerous recent investigations, is now summarised and in a convenient form, and will be highly appreciated by all students of zoology, and must remain for many years to come the standard work on the morphology of fishes.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Herms, W. B.—Recent Work in Insect Behaviour and its Economic Significance. Journ. Econ. Entom., 1909, vol. 2, pp. 223-230.

II.—Anatomy, Physiology, and Development.

Bruyant, L.—Larve hexapode de Trombididé parasite des insectes et rapportée à *Trombidium trigonum*, Heim. Zool. Anz., 1909, Bd. xxxiv, pp. 321-324, 5 figs.

Börner, C.—Die Tracheenkieman der Ephemeriden. Zool. Anz., 1909, Bd. xxxiii, pp. 806-823, 4 figs.

Crampton, G. C.—A Contribution to the Comparative Morphologie of the Thoracic Sclerites of Insects. Proc. Acad. Nat. Sci. Philad., 1909, pp. 3-54, plts. i-iii, 21 text figs.

Grove, A. J.—The Anatomy of *Siphonophora rosarum*, Walk. Pt. 1. The Apterous Viviparous Stage. Parasitology, 1909, vol. ii, pp. 1-28, plt. i.

The author gives an interesting account of the general anatomy of this species. He notes the absence of any definite organ comparable to the salivary pump described in other species, and fully discusses the structure and mechanism of the mouth parts.

Janet, Charles.—Sur la Morphologie de l'Insecte. Fasc. 27, pp. 75, 2 figs. Limoges: Ducourtieux et Gout, 1909.

Kepner, W. A.—Nutrition of the Ovum of *Scolia dubia*. Journ. Morph., 1909, vol. xx, pp. 125-141, plts. 1, 2.

Snodgrass, R. E.—The Thoracic Tergum of Insects. Entom. News, 1909, pp. 97-104, plt. vi.

Snodgrass, R. E.—The Thorax of Insects and the Articulation of the Wings. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 511-595, plts. 40-69.

This is an important paper, though it is doubtful if all will agree with some of the author's opinions. Briefly his conclusions are as follows: Assuming the genuineness of the fourth head segment, the head of insects is composed of six consolidated primary segments. The microthorax is the neck segment of the adult. The thorax proper consists of three segments, which are primary metameres, and there is no real evidence of each

having been formed through a fusion of two or more primitive segments. The original thoracic region may have consisted of more than three segments, but if so, the extra segments have disappeared. The thoracic sclerites conform to one general plan, which the author represents diagrammatically. The primitive tergum is a single undivided plate from the entire lateral margins of which the wings arise. The wing is hinged to the notum on the two notal wing processes, and is supported from below upon the wing process of the pleurum.

Incidently a number of interesting points are brought forward in the review of the special characters of the Orders. Verhoeff's view that the Thysanura are not insects "progenitori," but a degenerate branch of the primitive wingless insects, is regarded as the correct one. In the opinion of many this author's excellent work scarcely warrants his conclusions, and personally, in the light of more recent work, we dissent from this opinion.

The author has made a most valuable addition to the literature on insect anatomy, and has fully illustrated all points in wonderful detail.

W. E. C.

Stitz, H.—Der Genitalapparat der Neuropteren und seine Bedeutung für die Systematik derselben. SB. Gesell. naturf. Freunde, 1909, pp. 91-99, 10 figs.

III.—General and Systematic Biology, and Geographical Distribution.

Austen, E. E.—Notes on the Examination of Batches of Flies received from various centres in London, during the Summer and Autumn of 1908. Rpts. Local Gov. Bd., n.s. No. 5, 1909, p. 4, with table and plate.

Bagnall, R. S.—On *Urothrips paradoxus,* a new type of Thysanopterus Insects. Ann. Mus. Nat. Hungarici, 1909, vii, pp. 125-136, T. iii.

The author describes as new two interesting specimens collected in German East Africa, which are placed in a new Family, the *Urothripidae.*

Urothrips paradoxus, gen. et. sp. nov., possesses seven-jointed antennae, and single jointed maxillary and labial palpi, and there are eleven pairs of stigmata.

Bagnall, R. S.—On the Thysanoptera of the Botanical Gardens, Brussels. Ann. Soc. Entom. Belgique, 1909, T. liii, pp. 171-176.

The following new species are described: *Euthrips longipennis,* and *Cephalothrips spinosus.*

Bainbridge, May E.—Notes on some Parasitic Copepoda. Trans. Linn. Soc Lond. (2nd ser. Zool.), 1909, vol. xi, pp. 45-60, plts. 8-11.

Baker, C. F.—Studies in *Oxybelidae* I. Pomona Journ. Entom., 1909, vol. i, pp. 27-30.

Bezzi, M.—Le specie dei generi *Ceratitis, Anastrepha e Dacus.* Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 271-313.

Bezzi, M.—Gli scritti cecidologici del Prof. A. Costa. Marcellia, 1909, vol. viii, pp. 19, 20.

Blunck, H.—Färbungsvariation bei *Dytiscus marginalis,* Linn. Zool. Anz., 1909, Bd. xxxiv, pp. 337-345.

Borelli, A.—Scorpioni raccolti dal Prof. F. Silvestri nell' America settentrionale e alle isole Hawaii. Boll. Lab. Zool. R. Sc.. Agric. Portici, 1909, vol. iii, pp. 222-227.

Vaejovis silvestrii is described as a new species.

Borelli, A.—Forficole raccolte dal Prof. F. Silvestri nell' America settentrionale e nelle isole Hawaii. Ibid., pp. 314-328, 3 figs.

The following are described as new: *Anisolabis eteronoma, A. aporonoma, Paracosmia* (n. gen.) *silvestrii,* and *P. dugesi.*

Börner, C.—Über Chermesiden. V. Die Zucht des Reblaus-Wintereies in Deutschland. Zool. Anz., 1909, Bd. xxxiv, pp. 13-29.

Börner, C.—Neue Homologien zwischen Crustaceen und Hexapoden. Die Bei mandibel der Insekten undihre phylogenetische Bedentung. Archi-und Metapterygota. Zool. Anz., 1909, Bd. xxxiv, pp. 100-125, 9 figs.

Börner, C.—Japans Collembolenfauna. SB. Gesell. naturf. Freunde, 1909, pp. 99-135.

The following are described as new: *Protaphorura granulata, P. conjungens, Homaloproctus* (n.gen.) *sauteri, Odontella thauma, Achorutes japonicus, A. pterothrix, Proisotoma lamelligera, Isotoma negishina, I. carpenteri, I. occulta, I. pinnata* with vars. *v-album, melanocephala, coracina,* and *fasciata, I. gracilliseta, Pteronychella* (n.gen.) *perpulchra, Tomocerus cuspidatus, Pogonognathus beckeri, Entomobrya villosa, E. striatella, E. corticalis* (Nic.) v. nov. *affinis, E. amethystina, E. stenonyx, E. sauteri* with vars. *allospila* and *depicta, Ptenura bimaculata, Pseudosira gigantea, Cremastocephalus bicinctus, C. affinis,* Folsom, v. nov. *concolor, Sminthurinus fenestratus, Spyrotheca multifasciata* (Reut.), v. nov. *ornata, Sminthurus sensibilis, S. serrulatus, Dicyrtomina leptothrix, Dicyrtoma chloropus* (Tullb.), v. nov. *pallens, Ptenothrix corynophora* with n.vars. *sellata* and *cincta, P. denticulata* (Folsom), v. nov. *catenata,* and *P. setosa* (Krausb.), with n. vars. *picta* and *janthina.*

There are no figures of any of the species or varieties.

Buffa, P.—Contribuzione alla conoscenza dei Tisanotteri. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 193-196, 3 figs.

The following two new genera and species are described and figured: *Amphibolothrips grassii* and *Bebelothrips latus.*

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Cockerell, T. D. A.—Descriptions of some Bees in the U.S. National Museum. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 411-420.

Cognetti de Martiis, L.—Contributo alla conoscenza della drilofauna delle isole Hawaii. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 265-268, fig. 1.

Pheretima silvestrii, n.sp.

De Stefani Perez, T.—Altri Zoocecidii dell' Eritrea. Marcellia, 1909, vol. viii, pp. 7-18.

Ellingsen, Edv.—On some North American Pseudoscorpions collected by Dr. F. Silvestri. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 216-221.

Pseudogarypus is described as a new genus to contain the *Garypus bicornis* of Banks. *Ideobisium tacomense,* n. sp. is also described.

Enderllein, G.—Neue Gattungen und Arten nordamerikanischer Copeognathen. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 329-339, 4 figs.

The following are described as new: *Graphopsocus mexicanus, Dasydemella* (n.gen.) *silvestrii, Caecilius mexicanus, C. podacrophaeus, Myrmicodipnella* (n.gen.) *aptera,* and *Troctes prenolepidis.*

Essig, E. O.—Notes on Californian Coccidae II. Pomona Journ. Entom., 1909, vol. i, pp. 31-34, 5 figs.

Essig, E. O.—The Genus *Pseudococcus* in California. Ibid., pp. 35-46, 11 figs.

Essig, E. O.—*Aphididae* of Southern California II. Ibid., pp. 47-52, 4 figs.

Essig, E. O., and Baker, C. F.—Host Index to Californian Coccidae. Ibid., pp. 53-70.

Gestro, R.—Materiali per lo studio delle *Hispidaae.* Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 197-204.

The author treats of the genera *Brachispa* and *Xiphispa,* describing the following new species: *B. spinosissima,* and *X. latirostris.*

Grevillius, A. Y.—Ein Thysanopterocecidium auf *Vicia cracca,* L. Marcellia, 1909, vol. viii, pp. 37-45, figs. 1-4.

Griffini, A.—Le *Gryllacris* papuane ad ali bicolori. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 207-215.

The following species are described as new: *G. kirbyi, G. giulianettii,* and *G. punctipennis,* Walker, sub-sp. *dempwolfii.*

Imms, A. D.—On a new Species of Symphyla from Himalayas. Journ. Linn. Soc. Zool., 1909, vol. xxx, pp. 252-255, plt. 31.

Jepson, F. P.—Some Observations on the Breeding of *Musca domestica* during the winter months. Rpts. Local Gov. Bd., n.s. No. 5, 1909, pp. 5-8.

Kieffer, J. J. u, Herbst, P.—Ueber einige neue Gallen und Gallenerzeuger aus Chile. Centrabl. f. Bakter., 1909, pp. 119-126, 7 figs.

Leigh, H. S.—Preliminary Account of the Life-history of the Leaf Insect, *Phyllium crurifolium,* Serville. Proc. Zool. Soc. Lond., 1909, pp. 103-113, plt. 28.

Leonardi, G.—Altre notizie intorno alla *Diaspis pentagona,* Targ., ed al modo di combatteria. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 12-21.

Leonardi, G.—Seconda Contribuzione alla conoscenza delle Cocciniglie Italiane. Ibid., pp. 150-192, 64 figs.

The following are new : *Orthezia martelli, Kermes bacciformis, Phenacoccus graminicola, P. formicarum, Pseudococcus myrmecarius, P. longipes, P. cycliger, Ripersia libera, R. sardiniae, R. inquilina, R. hypogea, Eulecanium cecconi, Lecanopsis mirmecophila, Chionaspis strusca,* and *Hemiberlesia cecconi.*

Martelli, G.—Contribuzioni alla conoscenza della *Dicranura vinula,* L., e di alcuni suoi parassiti. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 239-260, 12 figs.

Martelli, G.—Notizie sall' *Eurytoma strigifrons,* Thoms., parassita dell' *Apanteles glomeratus,* Reinh., e dell' *Anilastus ebeninus,* Thoms. Ibid., pp. 261-264.

Masi, L.—Contribuzioni alla conoscenza dei Calcididi Italiani. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 86-149, 45 figs.

The following are new : *Encyrtus mayri, Aphicus philippiae, Chalcis modesta, Habrocytus distinguendus, Pseudocatolaccus* (n.gen.) *asphondyliae, Prospalta coniugata,* and *P. similis.*

Morley, Claude.—Observations on the Economy of the *Ichneumon manifestator,* Marsham (nee Linn.). An Historical Note. Journ. Linn. Soc., Zool., 1909, vol. xxx, pp. 271-274.

Nalepa, A.—Eine Gallmilbe als Erzeugerin der Blattgallen von *Cinnamomum zeylanicum,* Breyn. Marcellia, 1909, vol. viii, pp. 3-6.

Nalepa, A.—Der Erzeuger des *Erineum padinum,* Duv. Marcellia, 1909, vol. viii, pp. 45-48.

Petri, L.—Ueber die Wuzzelfäule phylloxerieter Weinstöcke. Zeit. f. Pflanzekkr., 1909, Bd. xix, pp. 18-48, 13 figs.

Reuter, E.—*Physopus basicornis,* n.sp. Marcellia, 1909, vol. viii, pp. 35, 36, 1 fig.

Silvestri, F.—Miriapodi. Dell' opera Il Ruivenzori rel. sci., 1909, vol. i, pp. 3-39, 89 text figs.

Silvestri, F.—Termitidae. Ibid., pp. 1, 2.

Silvestri, F.—Descrizione e cenni biologici di una nuova specie di *Asphondylia* dannosa al lupino. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 3-11, figs. i-xi.

Silvestri, F.—Appunti sulla *Prospalta berlesei,* How., e specialmente sui primi stati del suo sviluppo. Ibid., pp. 22-28, figs. i-vi.

Silvestri, F.—Contribuzioni alla conoscenza biologica digli Imenotteri Parassiti. Ibid., pp. 29-85, T. i, ii, figs. i-xlvi.

The three species treated of are *Ageniaspis fuscicollis* (Dalm.)., *Encyrtus aphidivorus,* Mayr., and *Oophthora semblidis,* Aur.

Silvestri, F.—A proposito di certe osservazioni sulla Tignola dell' olivo. Ibid., pp. 340-342.

Trotter, A.—Nuovi Zoocecidii della Flora Italiani. Marcellia, 1909, vol. viii, pp. 50-59, 2 figs.

Trotter, A.—Breve descrizione di alcune galle europee ed esotiche. Ibid., pp. 59-64.

van Leeuwen-Relinvaan, J. u. W. D.—Einige Gallen aus Java. Marcellia, 1909, vol. viii, pp. 21-35, figs. 1-17.

Weise, J.—Eine neue Coccinellide aus Mexico. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 205, 206.

Hyperaspis silvestrii, n.sp.

Wheeler, W. M.—Ants collected by Prof. F. Silvestri in Mexico. Boll. Lab. Zool. R. Sc. Agric. Portici, 1909, vol. iii, pp. 229-238.

The collection comprises an unusual number of interesting forms, amongst which there is a new and abberrant species of *Megalomyrmex* (*M. silvestrii*) and two other species, *Cremastogaster formosa* and *Ectatomma interruptum,* which do not seem to have been taken since they were described many years ago by Mayr.

Wheeler, W. M.—Ants collected by Prof. F .Silvestri in the Hawaiian Islands. Ibid., pp. 269-272.

Cerapachys (*Syscia*) *silvestrii,* n.sp.

Williams, F. X.—The Montery Pine Resin Midge, *Cecidomyia resincoloides,* n.sp. Entom. News, 1909, vol. xx, pp. 1-3, 1 plt.

Wilson, C. B.—Dragonflies of the Mississippi Valley collected during the Pearl Mussel Investigations on the Mississippi River, July and August, 1907. Proc. U.S. Nat. Mus., 1909, vol. xxxvi, pp. 653-671.

IV.—Agriculture and Horticulture.

Aldrich, J. M.—Western Spread of the Colorado Potato Beetle. Journ. Econ. Entom., 1909, vol. 2, p. 235.

Ballou, H. A.—The Flower-bud Maggot of Cotton. W.I. Bull., 1909, vol. x, pp. 1-28, 9 figs.

This pest is the larva of *Contarinia gossypii*, Felt, and a full account of the life-history is given. The remedial measures tried strike us as particularly weak. Turning the soil over to a depth of six or eight inches would we think prove as successful here as it has done with *Diplosis pyrivora*.

Buchman, E. R.—The Gum produced by *Bacillus radicicola*. Centrlbl. f. Bakter., 1909, Bd. xxii, pp. 371-396.

Butler, E. J.—The Mulberry Disease caused by *Coryneum mori*, Nom., in Kashmir, with Notes on the other Mulberry Diseases. Mem. Dept. Agric. India, Bot. Ser., 1909, vol. ii, No. 8, pp. 1-18, plts. i-iv, and 3 text figs.

The author gives a full account of this disease and also of the Mulberry Leaf Spot (*Septogloeum mori*), Mulberry Mildew (*Phyllactinia corylea*), and Mulberry Trunk-rot (*Polyporus hispidus*), all of which are well illustrated.

Chittenden, F. H.—The Rose-chafer. (*Macrodactylus subspinosus*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 11, rev., 1909, pp. 1-4, 1 fig.

Chittenden, F. H.—The Striped Cucumber Beetle (*Diabrotica vittata*, Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 31, 2nd rev., 1909, pp. 1-8, 2 figs.

Chittenden, F. H.—The Hop Flea-beetle (*Psylliodes punctulata*, Melsh.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. vi, 1909, pp. 1-92, plts. v-vii, and 19 figs.

Conradi, A. F., and Thomas, W. A.—Some Injurious Orchard Insects. Sth. Carolina Agr. Exp. Stat., Bull. 143, 1909, pp. 1-35 figs. 1-15.

Crosby, C. R.—On Certain Seed-infesting Chalcis-flies. Cornell Univ. Agric. Exp. Stat., Bull. 265, 1909, pp. 367-388, figs. 72-98.

Details the life-history of *Syntomaspis druparum*, Bohe., *Megastigmus brevicaudis*, Ratz., *M. aculeatus*, Swed., *M. spermotrophus*, Wachtl., *Evoxysoma vitis*, Saunders, *Prodecatoma phytophaga*, Crosby, and *Eurytoma rhois*, Crosby.

Davis, R. A.—Phylloxera-resistant Vines for the Transvaal. Transv. Agric. Journ., 1909, vol. vii, pp. 463-470, plt. 69, and 6 text figs.

Doane, R. W.—Notes on Insects affecting the Cocoanut Trees in the Society Islands. Journ. Econ. Entom., 1909, vol. 2, pp. 220-223.

Evans, I. B. P.—Maize Smut or "Brand." Transv. Agric. Journ., 1909, vol. vii, p. 445, plt. 66.

Evans, I. B. P.—Peach Freckle or Black Spot. Transv. Agric. Journ., 1909, vol. vii, p. 446, plt. 67.

Fawcett, H. S.—Scaly Bark of Citrus. Florida Agric. Exp. Stat., Bull. No. 98, 1909, pp. 73-80, figs. 1-3.

Fawcett, H. S.—Fungi Parasitic upon *Aleyrodes citri.* Univ. State of Florida. Thesis., 1908, pp. 1-41, plts. i-vii, 19 text figs.

The author shows that there are at least six species of fungi parasitic upon *Aleyrodes citri,* of these *Aschersonia aleyrodis,* Webber, is the most widely distributed parasite. It is easily isolated and grown in pure cultures. Healthy larvae of *A. citri* may be infected by spraying a mixture of conidia in water on infested trees.

Fletcher, J.—Report of the Entomologist and Botanist for the Year ending March 31st, 1908. Ann. Rpt. Exp. Farms 1907-8, 1909, pp. 2 + 183-213, 1 plt.

Forbes, S. A.—The general entomological Ecology of the Indian Corn Plant. Amer. Nat., 1909, vol. 43, pp. 286-301.

Froggatt, W. W.—So-called Fruit-flies that are not Fruit-flies. Agric. Gaz. N.S.W., 1909, vol. xx, pp. 364-369.

Gahan, A. B.—A Moth larva predatory upon the eggs of the Bagworm. Journ. Econ. Entom., 1909, vol. 2, pp. 236, 237.

Gates, B. N.—Bee Keeping in Massachusetts. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, pt. vii, 1909, pp. 81-109.

Grossenbacher, J. G.—A *Mycosphaerella* Wilt of Melons. N.Y. Agric. Exp. Stat. Geneva, Tech. Bull. No. 9, 1909, pp. 195-229, plts. i-vi.

The pathogeneity of the fungus (*M. citrullina,* C. O. Sm.), and the relation of its two spore-forms are established. Inoculation experiments were effective, and, with but a few interesting exceptions, the spore-forms of the fungus always appeared successively on the inoculated vines.

Gunn, D.—The Root Louse of Grape Vines (*Phylloxera vastatrix,* Planchon.). Transv. Agric. Journ., 1909, vol. vii, pp. 508-512, plts. 79, 80, and 2 text figs.

Hammar, A. G.—The Cigar Case-bearer. (*Coleophora fletcherella,* Fernald.). U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. ii., 1909, pp. 33-34, plt. i, ii, figs. 9-12.

Hayhurst, P.—Quack Grass (*Agropyron*), a Host of the Hessian Fly. Journ. Econ. Entom., 1909, vol. 2, pp. 231-234.

Headden, W. P.—Arsenical Poisoning of Fruit Trees. Journ. Econ. Entom., 1909, vol. 2, pp. 239-245.

Howard, A. and G. L. C.—The Varietal Characters of Indian Wheats. Mem. Dept. Agric. India, Bot. Ser., 1909, vol. ii, No. 7, pp. 1-66.

Howard, L. O., and Chittenden, F. H.—The Leopard Moth. (*Zeuzera pyrina,* Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 109, 1909, pp. 1-8, figs. 1, 2.

Howard, L. O., and Chittenden, F. H.—The Green-striped Maple Worm. (*Anisota rebicunda,* Fab.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 110, 1909, pp. 1-7, figs. 1-3.

Jenne, E. L.—The Codling Moth in the Ozards. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. 1, 1909, pp. 1-32, 8 figs.

Kelly, A.—Some Notes on the Diseases of the Potato Crop in Natal. Natal Agric. Journ., 1909, vol. xii, pp. 427-435, plts. i-iii.

Lefroy, H. M.—Eri or Castor Silk. Agric. Journ. India, 1909, vol. iv, pp. 125-133, plts. vi-xiii.

Mally, C. W.—Poisoned Bait for Fruit Fly. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 620-623, 1 plt., 5 text figs.

The following formula was used with excellent results:—sugar, 3lbs., arsenate of lead, 4ozs., water, 5galls. Fourteen applications were given, and the cost of materials worked out at about 4d. per tree, minus labour.

Rolfs, P. H., and Fawcett, H. S.—Fungus Diseases of Scale Insects and Whitefly. Florida Agric. Exp. Stat., Bull. No. 94, 1908, pp. 1-17, figs. 1-21.

The authors of this interesting paper point out that no danger need be anticipated from any of the scale-destroying fungi, as none of them attack fruit or other trees. Amongst the species experimented with are *Sphaerostilbe coccophila,* Tub., *Ophionectria coccicola,* E. and E., *Myraingium duriaei,* Mont., *Aschersonia flavocitrina, A. aleyrodis,* Webber, and a brown fungus of the Whitefly.

These six species have been known for years and used successfully. The peculiar life habits of scale insects and whitefly larvae make them especially liable to attacks of fungus diseases. Treating orchard pests by means of their diseases is regarded as the natural method, and hence the desirable one.

Silvestri, F.—Sguardo allo stato attuale dell' Entomologia Agraria Stati-Uniti del Nord America. Boll. Soc. Agric. Italiani, 1909, vol. xiv, pp. 1-65.

Sutton, Geo. L.—Treatment for Smut. Agric. Gaz. N.S.W., 1909, vol. xx, pp. 436-441, 3 figs.

Thomsen, F.—Notes on Termites. Transv. Agric. Journ., 1909, vol. vii, pp. 512-520, 1 fig.

Thomsen, F.—The Brown Locust Campaign, 1908-09. Transv. Agric. Journ., 1909, vol. vii, pp. 521-526, plts. 81-83.

Thornton, R. W.—Take-all or Whiteheads in Wheat. (*Ophisbolus graminis*). Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 526, 527.

Truelle.—L'emploi des composés arsenicaux en arboriculture aux Etats-Unis. Bull. Agric. de l'Algérie, 1909, pp. 230-238.

Webster, F. M.—The Spring Grain-Aphis or so-called "Green Bug." U.S. Dept. Agric., Bur. of Entom., Circ. 93, rev., 1909, pp. 1-22, 10 figs.

Webster, F. M., and Reeves, G. I.—The Wheat Strawworm (*Isotoma grande*, Riley.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 106, 1909, pp. 1-15, 13 figs.

Wilson, C. S., and Reddick, D.—The Black Rot of the Grape and its Control. Agric. Exp. Stat. Cornell Univ., Ithaca, Bull. 266, 1909, pp. 391-411, figs. 99-110.

Woglum, R. S.—Fumigation Investigations in California. U.S. Dept. Agric., Bur. of Entom., Bull. No. 79, 1909, pp. 1-73, 28 figs.

V.—Forestry.

VI.—Fisheries.

VII.—Medicine.

Anon.—Does Malaria ever occur Epidemically without the Agency of Anophelines? Lancet, 1909 (July 24th), pp. 237, 238.

Werner, H.—Studies regarding Pathogenic Amoebae. Ind. Med. Gaz., 1909, vol. xliv, pp. 241-245, 7 plts.

A useful translation by Dr. W. D. Sutherland, from the "Archiv. v Schiffs und Tropenhygiene."

THE

JOURNAL OF ECONOMIC BIOLOGY.

SOME NOTES ON THE DISTRIBUTION OF *GLOSSINA PALPALIS*, ROB-DESV.

BY

S. A. NEAVE, M.A., B.Sc.

WITH MAP.

THE following notes on the distribution of *Glossina palpalis*, Rob-Desv, refer more particularly to the South-Eastern limit of the distribution of that species as at present known. They were made during more than four years travelling in Northern Rhodesia and in the Katanga or South-Eastern district of the Congo Free State. Some of these notes, especially those relating to Katanga, have already been published in the report of the Katanga Medical Commission, and embody the views published by Dr. Sheffield Neave in the body of that report and by myself in the Annexe No. 1 thereto. Since, however, that report has had a limited circulation, and I am now in possession of more facts relating to Northern Rhodesia, it is perhaps expedient, in view of the importance of the question, to discuss the matter again.

A considerable study of the general fauna of this part of Africa, shows it to be of great interest, and to be the meeting place of two or more zoological regions. I hope to deal with this question more fully elsewhere, when some account of my general zoological collections is published. Before recounting the details of the distribution of *G. palpalis*, it is necessary to give some description of the geography of the country. The chief geographical feature of this region is the great Congo Zambezi watershed, which is never of much less elevation than 4,500 feet. Starting from the boundary of German East Africa, it extends through N.E. Rhodesia in a south-westerly direction. About Lat. 13 S. it turns westward, and forms the boundary between the Congo Free State and N.W. Rhodesia as far as the Angolan frontier. The fauna of this high plateau country,

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which is often very wide on both sides of the watershed, has affinities with that of areas of similar elevation in Southern Angola and the regions of the great lakes further north. Descending off this plateau into the *Zambezi* basin, one finds a fauna which is mainly *South African* in character; on the *Congo* side of the watershed, on the other hand, at the same elevations, the fauna begins at once to assume the characteristics of that of the Western Tropical regions.

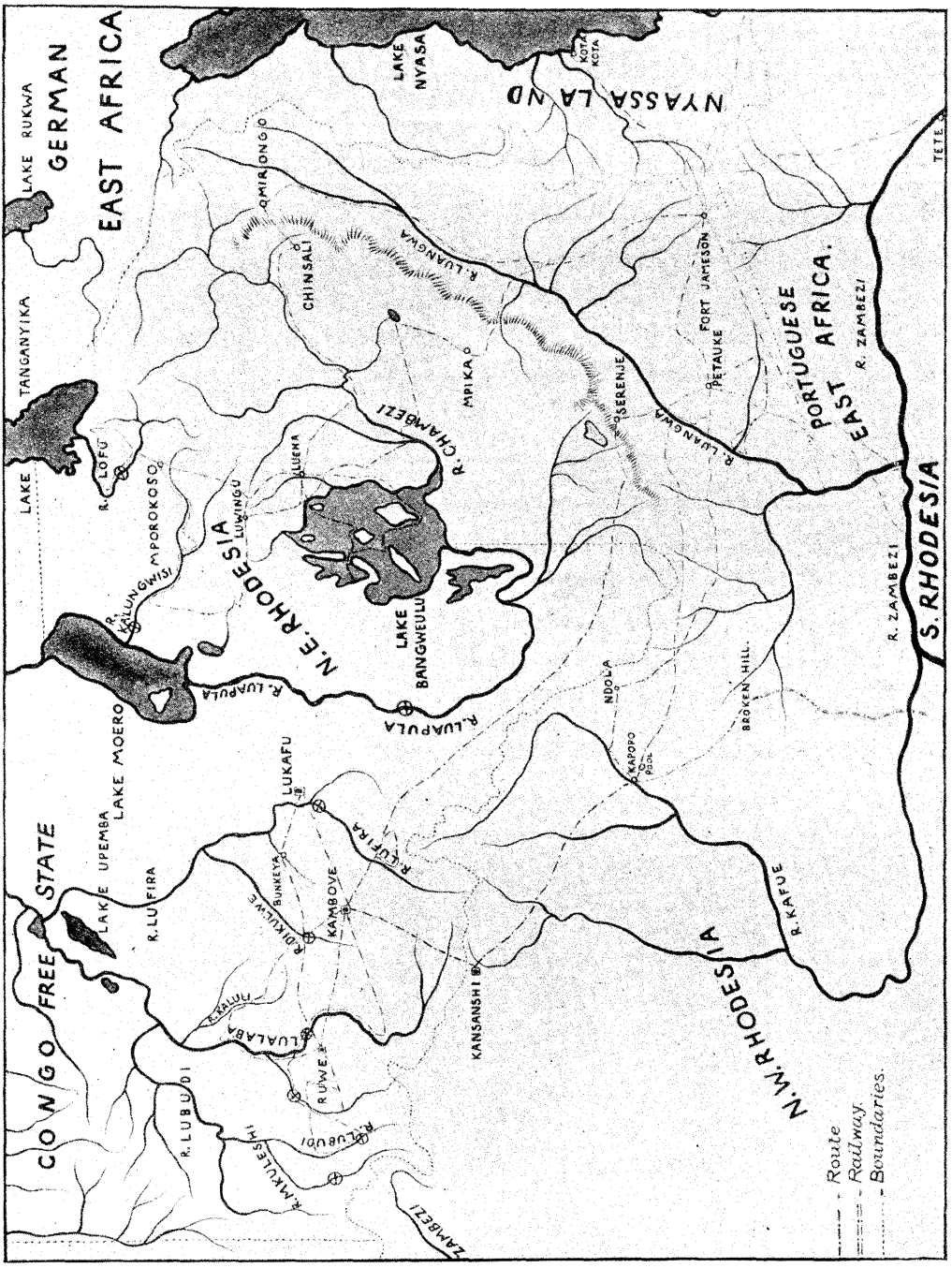
Now *Glossina palpalis,* so far as at present known, occurs *only* in this region, on the rivers and lakes of the Congo side of the watershed up to some point between 3,000 and 3,500 feet. Further, it closely coincides in its range with that of the Western Tropical fauna above mentioned.

The accompanying sketch map shows approximately the highest points on the Congo rivers on which *G. palpalis* is known to occur.

The next point of importance is the character of the river banks in these regions; a factor of the greatest importance in determining the presence or absence of *palpalis,* at least on the edge of its distribution.

In the high plateau country, near the watershed in both the Congo and Zambezi basins, the larger rivers run through more or less flat country in deep perennial channels. The banks are, for the most part, grassy, though occasionally moderately wooded. This description applies to the upper waters of all the plateau rivers, besides the whole of the Chambezi river and the shore of L. Bangweolo.

In the Zambezi basin, on the lower ground, the rivers run in wide, shallow, and sandy beds, the banks being often largely covered with Phragmites reed. In these rivers, of which the Luangwa may be taken as typical, the channel is only filled when the river is in flood at the height of the wet season. At other seasons the river is very shallow, and leaves exposed sandbanks and islands, often of considerable size. In no part of this area can we say with certainty that *G. palpalis* has been found. It is true that there are in the National Collection the four historic specimens (now considered to be intermediate between typical *G. palpalis* and its form *wellmani,* Aust.), supposed to have been collected by Sir John Kirk on the Upper Zambezi in 1864. We must remember, however, the fact that the specimens, which are in bad condition, date from a time when modern views in Museums as to the primary importance of labels were not in existence. Further, no other specimens are known from the whole of the Zambezi Valley, in spite of that region being now vastly better known. Judging also by the British Museum series the form *wellmani,* Aust., must be considered the southern race of



SKETCH MAP OF NORTHERN RHODESIA, ETC., showing the known limits of the distribution of *Glossina palpalis*. The highest point on the rivers, at which the insect has been found, is marked O.

palpalis. Except for one intermediate from L. Tanganyika, which apparently occurred among typical *wellmani*, all *palpalis* of the type form, as well as intermediates toward *wellmani*, in the National Collection, come from much further north and west. In these circumstances we should certainly expect Zambezi specimens, if genuine, to be *wellmani*.

We are, I think, on the whole justified in considering the former existence of a form of *palpalis* in the Zambezi Valley as non-proven, more especially as no explanation of its entire disappearance from the Zambezi Valley has been offered.

To return to the Congo side of the region under discussion. As the sketch map shows the more important rivers from west to east are the Lubudi, Lufupa, Lualaba, Dikulwe, Lufira, Luapula, Kalungwisi, and Lofu.

On descending from the high ground, the points at which *G. palpalis* makes its appearance on the banks of these rivers have a marked relationship to the geographical features. After a course of varied length through flat plateau country, these rivers usually descend rather abruptly through a series of gorges into the lower ground. At this point the banks begin to become heavily wooded, and *it is at these points*, usually near the top of the gorge, where present, that *palpalis begins to appear*, as also do the other insects characteristic of the Western Tropical Region, as mentioned above. It should be noted that *below* these points *palpalis* seems to occur wherever the banks are suitable. There are sometimes gaps in the distribution of the insect on the lower ground where the river passes through flat alluvial plains with grassy banks. In the case of the Lubudi River, and also, I understand, of the Luapula (the only one I have not personally visited), the descent of the river from the high ground is much more gradual. In these cases the point where the insect first appears, is *not* accompanied by any marked change in the character of the well-wooded banks. This fact, if correct, emphasizes the importance of *elevation* as the primary factor in checking the range of the species. The Kalungwisi River, in N.E. Rhodesia, presents an interesting abnormality to the above rule. On this river *palpalis* occurs for some 10 to 15 miles at its mouth, possibly representing an infection from the shores of Lake Mweru. Some thirty miles further up the river passes through a considerable stretch of broken country. In this area, which is in every way suitable to it, being densely forested, and harbouring many insects of the Western Tropical region, I could find no trace of it. It is true that there is a flat plain of considerable size, where the river has grassy banks between this point and the *palpalis* haunted area near

the mouth, but there would also appear to be some anti-*Glossina* factor in the Kalungwisi valley. *G. morsitans,* Westw., though game is very plentiful, seems to be also entirely absent therefrom. This is all the more remarkable, as only some 30 to 40 miles to the N.E., in the valley of the Lofu, both species of *Glossina* are extremely plentiful. What this factor may be, it seems impossible at present even to suggest. Some knowledge of it would perhaps provide an explanation of the strange belts and patches in which *morsitans* occurs.

Though not germane to the subject of these notes, there is one point of interest in the habits of *G. palpalis* which is perhaps worth mentioning. Theobald has recently suggested[1] that *G. palpalis* is perhaps confined to the neighbourhood of rivers, etc., from the necessity of having to constantly drink water. Personally, I think that this is more probably due to an instinctive dislike of the insect to leave areas where the atmosphere is of the humidity necessary for the development of its offspring. It was nevertheless of interest in this connexion to find in Katanga that some of our natives, when bribed to collect *palpalis* where it was scarce, used to sit on the river bank, after having wetted their legs in the water. This provision of a wet surface, on which the insect could conveniently absorb moisture, certainly proved an attraction to it.

To sum up, *G. palpalis*, at least on this, the south-eastern edge of its distribution, is confined to the well-wooded river banks and lake shores of the Congo basin up to about 3,400 feet. It is not *known* to occur at similar elevations in the basin of the Zambezi, where the insect fauna generally is certainly different. The chief barrier to its southern spread, apart from the character of the river bank, seems to be elevation above sea level. This barrier is here provided by the great area of high plateau forming the Congo-Zambezi watershed.

Attention has recently been called to the possibility of infection of the Zambezi valley by this barrier being crossed by the projected railways now advancing northward. Though this state of things seems hardly likely in the immediate future, it has certainly to be provided against. Whether, if artificially introduced into the Zambezi Valley, *G. palpalis* could survive there, seems an impossible question to answer until we know more of the factors which are essential to its well being. A vast part of the mid and lower Zambezi Valley seems to be totally unsuitable to it. Whether, however, this insect could exist in such places as the neighbourhood of the Victoria Falls or the Kabroabasa Rapids of the lower Zambezi is less certain.

[1] Bulletin of the Sleeping Sickness Bureau, pt. 6, p 245.

THE LIFE-HISTORY OF *CALLIDIUM VIOLACEUM* (LINN.).

By

JOHN W. SHOEBOTHAM, N.D.A.

With Figures 1-12.

Contents.

I.—Introduction.

Soon after coming to Berkhamsted in 1908, I found that some of the wooden fences in the neighbourhood were being bored and seriously damaged by some insect, but at the time the actual cause of the injury was not ascertained, as no insect could then be found. About the middle of May, beetles were found emerging from the borings, and these were caught and kindly identified for me by Mr. Walter E. Collinge, M.Sc., as *Callidium violaceum* (Linn.).

An extended inspection of the fences in the district, showed that the beetle had done, and was still doing, considerable damage, and as no account of the attack could be found in English economic literature, excepting an early paper by Kirby,[1] its life-history was worked through, an account of which is given in the following pages.

He records some observations made by Mr. James Trimmer of Old Brentford, of an attack on Spruce and Scotch Fir. His account of the life-history is in accord with that given here, but he is mistaken in describing the larva as legless.

Mr. Trimmer observed the female to lay her eggs on apple, pear, plum, and cherry, but does not say whether these developed. In the case on the Spruce the beetles emerged from the 20th of May to the 20th of June.

[1] Kirby, Rev. William.—"Some Observations on Insects that prey upon Timber, with a short History of the *Cerambyx violaceus* of Linnaeus." Linn. Trans. (read Nov., 1799), vol. v, p. 246-260, with pl. 12.

The fact that the larvae live under the bark made the investigation less easy, but these have been bred in the Laboratory in addition to observations on them in the field.

My best thanks are due to Mr. Walter E. Collinge, M.Sc., for the identification of the beetle and for other generous assistance throughout the inquiry.

II.—Systematic Position.

The following shows the systematic position of the species amongst the Coleoptera:—

Group: Longicornia.
Family: **Cerambycidae.**
Tribe: **Cerambycina.**
Genus: **Callidium,** Fab.
Species: *violaceum,* Linn.

As no English name, that I am aware of, has been applied to this beetle, it might be called "The Flat Violet Beetle."

III.—Life-History and Habits.

There is a certain amount of variation in the life-history, which is noticeable in the larval stage, as amongst larvae from the same batch of eggs, some were ready to pupate, when others were little more than half grown.

The adult beetles emerge from the borings during the middle and latter part of May, and the beginning of June (rather earlier in 1908 than 1909). They may be seen on the rails and posts, and flying from one to the other, especially when the sun is out.

(*a*) *The Egg.*—Copulation takes place, and the female commences to lay her eggs under the pieces of rough bark and in crevices. She exercises great care in the selection of suitable positions for placing the eggs, feeling about with her long ovipositor, and often trying several niches before she finds one to suit her.

The number of eggs placed together varies, in one case a female was observed to place eleven eggs under a projecting piece of bark, taking seven minutes to complete the operation. In other cases the eggs were laid singly, or in groups of three or four. In the case of the larger groups, no attempt at arrangement of the eggs was noticed.

The egg (Fig. 1) is elongate-oval, a little broader at one end than the other, white in colour, and devoid of any markings. Length, 1.6 mm., breadth at broadest part, .45 mm.

(*b*) *The Larva.*—After hatching, the larva bores through the bark and commences to eat a narrow channel between the bark and the

wood, eating about equally of each, so that the markings can be seen as well on the bark as the wood. As it grows in size, it eats a gradually widening passage, which it leaves full of bore dust. Where there is only one larva at work on a piece of timber, its course is easily followed and the markings are definite (Fig. 10), but where several are working together, they cross and recross their own or other borings (Fig. 12), so that the markings of each are only traced with difficulty.

A point that was puzzling in tracing the course of the larvae, was that the markings of two separate individuals could be seen up to a certain point, but when one had just crossed the other, it would suddenly come to an end. It is only recently that a probable explanation of this phenomenon has presented itself. After putting

Fig. 1.—Outline of the Egg.

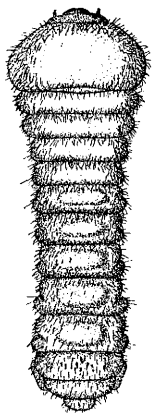


Fig. 2.—Larva, dorsal view.

several of the larvae together in a petri dish, it was noticed that one larva, which was full grown, was keeping very close to a smaller one and making it wriggle. On closer examination it was found that the smaller one had been badly bitten in two places and eventually died. I think it probable, therefore, that this takes place under the bark and so may account for some of the perplexing markings.

When the larva is about half grown, it is not content with eating directly in front of it, but turns to the right and left, eating out large sinuses still between the bark and wood and always within the limits of the piece of timber, though they get very near the edge at times.

When nearly full grown, from the end of September onwards, the larva leaves its position between the bark and the wood and for the first time bores directly into the wood, making a chamber in which to pupate and spend the winter. The entrance to this chamber

is oval, nearly always oblique, and from 4.5 to 7 mm. in length. The boring (Fig. 11) goes straight into the wood for a little way and then gradually curves round and runs parallel to the grain of the wood. The length of the chamber is about 50 mm., and a little broader at the end than at the entrance.

Judeich and Nitsche[1] figure the borings and pupal chamber of an allied species (*Callidium variabile* (Linn.)).

The larva (Fig. 2) is of a creamy white colour, except the head and legs, which are brown, and the mandibles, black. The body segments are well marked, and covered with short golden yellow hairs, which are numerous at the sides of the segments, and almost absent in the middle.

A spiracle is found on each side of the mesothorax, and on the 1st to the 8th abdominal segments. The spiracles are oval in shape

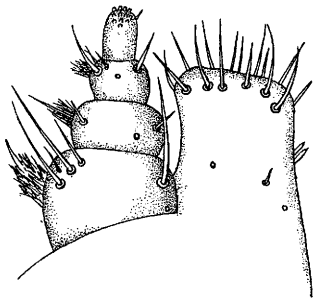


FIG. 3.

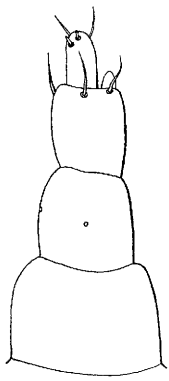


FIG. 4.

Fig. 3.—End of right maxilla and maxillary palp, from below.
Fig. 4.—Left antenna, from above.

and light brown in colour. Head small, much broader than long. Ocelli (Fig. 5) black, two on each side of the head, situated one dorsal and the other ventral to the antenna and mandible. The maxillary palp (Fig. 3) is 4-jointed and conical; 1st joint broader than long, ventrally with three or four long bristles, dorsally with numerous short hairs, and on its outer side with a large tuft of hairs; 2nd joint broader than long, ventrally with two short bristles, laterally with a tuft of hairs and one strong bristle, dorsally with many short hairs; 3rd joint, about as broad as long, with two strong ventral bristles, laterally with a small tuft of hairs, dorsally with short hairs; 4th joint, about as long as the third, but much narrower, ventrally

[1] Lehrbuch der Forstinsektenkunde, 1895, Vol. i, p. 584.

with twelve or thirteen short papillae, dorsally with one short bristle on the inner side. The end of the maxilla has several long bristles on the ventral side and numerous short hairs dorsally.

Antennae (Fig. 4), 4-jointed, 1st joint, broad, without hairs; 2nd joint without hairs in all specimens examined, except one, which had a strong bristle on the outer side; 3rd joint, about equal to 2nd in length, with a blunt-conical protuberance on the inner side and a curved bristle immediately above it. There is also a dorsal bristle and one ventral on the outer side; 4th joint, narrow, like the last joint of the maxillary palp, with two ventral bristles and two short thick dorsal ones.

Prothorax, large, flattened on top, twice as broad as long, and about one and a half times as broad as the 8th abdominal segment. Mesothorax, short, not so broad as the prothorax. Metathorax, similar to the mesothorax, but a little narrower. The pro-meso- and meta-thoracic segments each bear a pair of short legs (Fig. 6), which

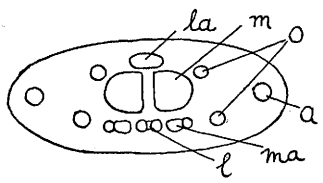


FIG. 5.

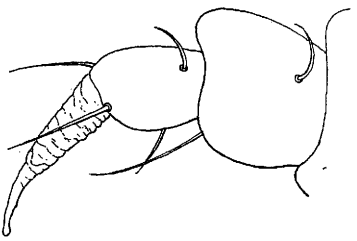


FIG. 6.

Fig. 5.—Diagrammatic view of the head, from in front, to show position of the ocelli, *la*, labrum; *m*, mandible; *o*, ocelli; *a*, antenna; *ma*, maxilla; *l*, labium.

Fig. 6.—Claw and last two joints of the leg.

are brown in colour. Each ends in a single claw, which is tapering, scarcely curving, and has a roughened surface.

The 1st and 2nd abdominal segments are short, about equal to the metathorax in length. In the next five segments, each succeeding segment is a little longer than the previous one and bear fleshy tubercles on the dorsum, which are most noticeable on segments 5, 6, and 7. Tubercles are also present on the ventral side and aid in locomotion.

The 8th segment is partially retractile within the 7th, and the 9th within the 8th. The anal segment is rounded, visible from above, and appears like a 10th abdominal segment.

Length of full grown larva, 16 mm.

(*c*) *The Pupa.*—When the pupal chamber is completed, the larva turns round and pupates with its head towards the entrance, and in

this position passes the winter. In two cases the pupae were found lying free in the bore-dust under the bark, not having made a hole in which to pupate.

The duration of the pupa stage has not been determined with

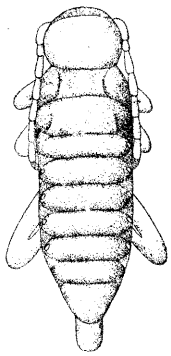


Fig. 7.—Pupa, dorsal view.

certainty, as those under observation died, but it seems that it passes the winter in this stage, the imagines emerging the following May and June.

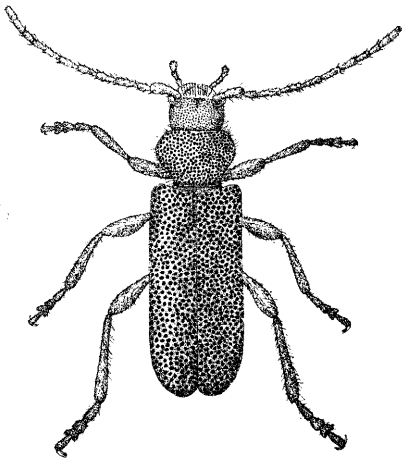


Fig. 8.—Imago (female) dorsal view.

The pupa (Fig. 7) is of a creamy white colour. The head is folded under the prothorax and scarcely visible from above. Prothorax large, flattened on the top. The legs are folded up under the body, but the femora can be seen projecting from the sides, especially those of the 3rd pair. The antennae are transparent, and run along

the sides of the thorax, bend over the 2nd pair of legs and turn under the body. The first five abdominal segments bear spiracles.

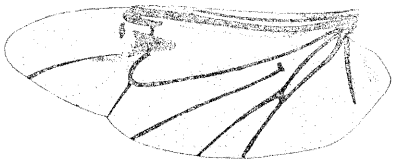


Fig. 9.—Left wing.

Body without hairs, somewhat flattened, of the same width to the 5th abdominal segment, then gradually tapering behind.

Length of pupa, 9-11 mm.

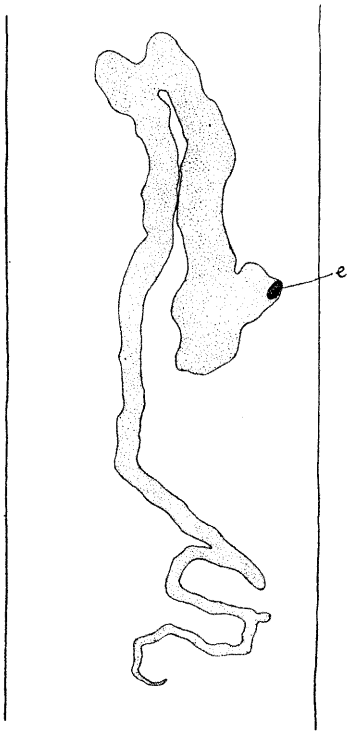


Fig. 10.—Borings of larva on Spruce pale. *e*, entrance to pupal chamber.

(*d*) *The Imago*.—When the beetle is ready to leave the pupal chamber, it bores through any dust left by the larva, and if the bark has peeled off, it can immediately come out, but if the bark is still on,

it has to bore through it from the entrance of the pupal chamber, and then it is free to pair and commence another life-cycle.

Imago (Fig. 8), elongate, flattened, of a dark blue or violet colour. Head, about as broad as one of the elytra, closely and rugosely punctured. Eyes, convex posteriorly, concave anteriorly. Antennae, inserted in front of the hollowed part of the eye, 11 jointed, 1st joint largest, slightly curved, 2nd joint, smallest, less than half as long as the 1st, the next four segments about equal in length, a little less than the 1st, 7th joint, a little less than the 6th, the four terminal segments short, about equal in length, a little longer than the 2nd. All the segments are clothed with hairs, which are stronger and more numerous on the first five segments. The head is covered with short hairs and is a little depressed between the antennae. Prothorax, broader than long, covered with short hairs,

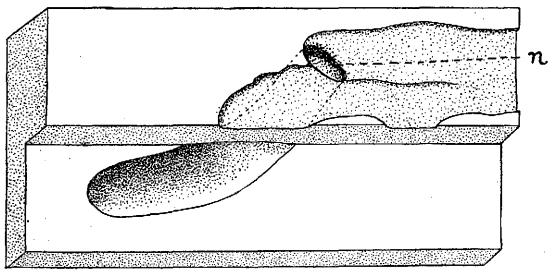


Fig. 11.—Larch, bored by larvae with part cut away to show pupal chamber. *n*, entrance to pupal chamber.

with the sides strongly rounded, punctures coarser than on the head. Elytra, broader than the prothorax, coarsely and rugosely punctured, coarser than on the prothorax, with a single hair arising from each depression, apex rounded. The venation of the wing is shown in Fig. 9. Legs, shiny, long, especially the 3rd pair, femur, flattened and much enlarged, tarsus, apparently 4-jointed, really 5-jointed, the 4th joint being small and fused with the 5th, which ends in two toothless claws. The end of the tibia is furnished with two spines.

Length, 9-14 mm. Length of ovipositor of female, 7 mm.

The males may be distinguished from the females by their smaller size and the relative length of the antennae, which in the male are a little shorter than the body, while in the female they are much shorter.

IV.—Damage Done and Timbers Attacked.

Damage is done in two ways:—

1. By boring between the bark and the wood, and later into the wood, thus weakening the fence.

2. By allowing water and fungi to enter into, and cause the rotting of the wood.

Fig. 12.—Piece of Larch, bored by larvae, showing entrances to six pupal chambers.

This species seems to confine its attention to conifers, the only timbers I have found attacked being larch and spruce. In one case a fence nearly one hundred and fifty yards long had every larch post and rail bored by the larvae, but the few oak posts present were untouched.

A piece of wood badly attacked has the appearance, as shown in Fig 12.

The only case observed on spruce was on a few pales (Fig. 10), and these were only a few yards from some larch rails that were badly attacked.

In the Berkhamsted district, it has not been observed to attack living trees, though in some cases it was ascertained that the wood attacked had been grown and cut up on the estate.

Fowler[1] gives the following records:—"In decaying fir posts and stumps; local, but sometimes abundant; Darenth Wood, Roehampton, Forest Hill, Shirley, Leith Hill, Croydon, Dulwich, Walton, Mickleham, Cowfold, Shiere, Reigate, Shipley, etc.; Lowestoft, Hastings, New Forest, Devon; by hundreds for four or five years in wood of an old summer-house at Cirencester, Binley, near Coventry, and Manchester."

V.—Control.

Nothing can be done in the way of remedial measures unless the damage is detected before the larvae make their way into the wood to pupate. If this can be done, the bark should be stripped off the posts, when the larvae will be dislodged, and exposed to the weather, and for the birds to devour them.

Where badly attacked, the fencing should be pulled down and burnt during the winter, to destroy the pupae.

As a means of prevention, timber used for fencing should be creosoted or painted with tar, to prevent egg laying, it being found that when so treated it is not attacked.

As mentioned by Kirby, timber used for fencing or for wood buildings should have the bark stripped off, as this will prevent egg-laying and subsequent attack.

The Cooper Research Laboratory,
Berkhamsted.
November 8th, 1909.

[1] British Coleoptera, vol. iv, p. 223.

NOTE ON *AMERUS NORMANI*, CLLGE. & SHB.

By

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

SINCE the publication of the description of the Collembolan named by Mr. Shoebotham and myself *Amerus normani*,[1] we have been fortunate enough in meeting with more and better material, and further examination has led us to the view that this species must be referred to the genus *Megalothorax*, Willem.[2]

In these later examples the head shows more distinct from the thorax than in those previously examined, and, further, the antennal sense organs and furcal hairs described by Börner[3] are both present.

The fact that the material first examined seemed so conclusive only serves to emphasise how exceedingly important it is, in dealing with this order of insects, to examine and describe in the minutest detail the integumentary structures. Conclusions drawn from the gross morphology generally give one erroneous ideas as to the affinities of species and genera, whilst the minuteness and accuracy with which one investigates must ever be the key to a better understanding of these interesting insects.

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[1] Journ. Economic Biology, 1909, vol. iv, [p. 45-50, pl. vi.

[2] Ann. Soc. Ent. Belg., 1900, vol. 44, pp. 7-10, pl.

[3] Wytsman's Gen. Insectorum, 1906, pp. 1-5, pl. See also Apterygoten-Fauna von Bremen, 1901, p. 82, figs. 34 and 35.

[JOURN. ECON. BIOL., December, 1909, vol. iv, No. 4.]

REVIEWS.

Austen, E. E.—Illustrations of African Blood-Sucking Flies, other than Mosquitoes and Tsetse-Flies. Pp. xv + 231, 13 plts. and 3 figs. London: 1909. Published by the Trustees of the British Museum. Price £1 7s. 6d.

This work deals with Blood-Sucking Flies of Africa, south of the Sahara, though Egypt is also included. The plates provide coloured illustrations of one hundred and two species, and the endeavour that those represented shall be readily recognisable from the figures, without the necessity of consulting detailed descriptions, has been fully realised. The notes on life-history, habits, and distribution are based on the latest available information, while the all-important subject of the dissemination of disease has been kept prominently in view, the statements of the investigators and observers being summarised under special headings. A noteworthy feature of the book is a chapter devoted to "Lists of African Blood-Sucking Flies at present known, arranged under Countries," enabling those interested in a particular Colony or Protectorate to see at a glance what species are known to occur there, and such will undoubtedly prove of great value.

The work is an important addition to the Natural History Museum publications, and a most valuable contribution to our knowledge of the Diptera of the African continent, and will be welcomed by economic entomologists and dipterologists generally throughout the world as a standard monograph upon the species it treats of.

W. E. C.

Blanchard, R.—L'Insecte et L'Infection, histoire naturelle et médicale des Arthropodes pathogènes. Fasc. Pp. 160, 197 text figs. Paris: Librairie Scientifique et Littéraire, 1909. Price 6 fr.

The first part of Professor Blanchard's work deals with the class Acariens, in which are included the Mites and Ticks. Chapter i is devoted to a general account of the morphology and anatomy of the *Ixodidae,* which is followed by one on the evolution and biology, the remaining portion of the work being devoted to descriptions of the different genera and species.

The majority of figures are poorly reproduced and badly printed.

W. E. C.

Boyce, Rubert W.—Mosquito or Man? The Conquest of the Tropical World. Pp. xvi + 267, 44 figs. London: John Murray, 1909. Price 10/6 net.

If for no other reason than that of educating the public mind to the vast importance of the Tropical Medical movement, this book will be welcomed by many. But it has an equally important value for the lucid yet concise history it gives of the important scientific discoveries that have been the outcome of this movement.

It is a great achievement to be able to write, as the author does. "The campaigns show that the three great insect-carried scourges of the tropics—the greatest enemies that mankind has ever had to contend with, namely, Malarial, Yellow Fever, and Sleeping Sickness—are now fully in hand and giving way, and with their conquest disappears the awful and grinding depression which seems to have gripped our forefathers. Now the situation is full of hope. The mosquito is no longer a nightmare; it can be got rid of. The tropical world is unfolding once again to the pioneers of commerce."

Professor Boyce commences by detailing the foundation of the Tropical Medicine movement in England, and pays a high tribute to the practical and far-seeing Minister, the Right Hon. Joseph Chamberlain. The growth of general and applied sanitation in the tropics is next dealt with, and the old doctrine of the miasmatic origin of disease. The forerunners of the discoveries of the mosquito origin of disease, such as Dr. Nott, Dr. Beauperthny, Daniel Blair, and Sir Patrick Manson, each are given their share of the honour to which they are so justly entitled.

Manson's discovery of *Filaria,* and the researches of Laveran and Ross form most fascinating chapters, followed by equally interesting ones on the plan of campaign against the mosquito, and the various insect-borne diseases.

To quote the author's own words: "the narrative would appear more like a fairy tale were it not based upon easily accessible reports and figures."

It is a book that cannot fail to command a wide sale, appealing as it does to all who are interested in scientific discovery, and also on account of the eminently practical bearing of such, and their immense importance to humanity.

A fuller index would have been a great acquisition.

W. E. C.

French, C.—A Handbook of the Destructive Insects of Victoria, with Notes on the Methods of Prevention and Extirpation. Part IV. Pp. 195, plts. lxv—xcviii. Melbourne: Osboldstone and Co., 1909. Price 2s. 6d.

The earlier parts of Mr. French's Handbook have been known to economic biologists for some years as concise and beautifully illustrated treatises upon the injurious insects and insect-eating birds of Victoria.

We welcome part iv, in which the high standard set at the commencement is fully maintained. The work opens with a copy of the "Amended Vegetation Diseases Act," and a List of the insects proclaimed under that Act, by Mr. E. Meeking. Then follow accounts of Fruit Flies, various insects injurious to fruit and forest trees, the Horse Bot Fly, and fourteen species of insect-eating birds. An Appendix detailing certain "materials in use for the destruction of noxious insects," brings to a conclusion the fourth part of a very interesting and practical work, which must prove very valuable to Victorian farmers, fruit growers, and agriculturists generally.

W. E. C.

Lefroy, H. M., and F. M. Howlett.—Indian Insect Life. A Manual of the Insects of the Plains. Pp. xii + 786, 84 plts. and 536 text figs. Calcutta: Thacker, Spink and Co., 1909. Price 30s.

The planning, superintending and writing of a work like the one before us is a task that the casual reader scarcely realises, and when this work has been crowded into the leisure of a busy life, we feel that every credit is due to Mr. Maxwell-Lefroy and his staff for what must be the foundation of economic entomology in India.

There are many points with which we disagree, *e.g.*, classification, the absence of references, the quotation of authors, etc., etc., but as these are so insignificant when compared with those with which we are in hearty accord, and for which we have only the warmest praise, we prefer to direct attention to some of the latter.

Mr. Lefroy is responsible for the greater portion of the work, whilst Mr. Howlett has written the sections dealing with Mallophaga, Diptera, *Cimicidae* and Anoplura, and Mr. I. H. Burkill a short and interesting interlude on Insects and Flowers.

The author opens with a comprehensive Introduction, in which he discusses the zoological position of insects, instinct and habit, classification, entomology in India, zoo-geographical divisions, food and habitat, and the relationship of insects to man.

Apart from the valuable descriptions, life-histories, and strictly economic information, all of which are given in great detail, accompanied by a wonderful wealth of illustrations, a series of most interesting sections are interspersed dealing with such subjects as, Where Insects Live, Cosmopolitan Insects, Deceptive Colouring, Attraction to Light, Gregariousness, Aquatic Insects, Relative Duration of Life, Myrmecophilous Insects, Insects as Food, Migration, How Insects protect themselves, Blood-sucking Insects, Song in Insects, etc.

All sections have received very thorough attention, indeed, we know of no other work on the Class Insecta that contains such a wealth of information, very much of which is original, whilst much has not been easily accessible heretofore.

A few words must be said in praise of the figures and plates. We know of no work on insects in which the half-tone and line blocks approach the high standard seen here. Of the plates the figures and colouring are all excellent, but it is a great pity that the tinted background was not omitted as on plates ii-vi. In only one instance has this added to the clearness of the figures, whilst in many cases, *e.g.*, plts. x, xvii, xix, xxi, and others, it has seriously detracted from their value.

Mr. Lefroy has made a notable addition to entomological literature, and one upon the completion of which he may feel justly proud.

W. E. C.

Troup, R. S.—Indian Woods and their Uses. Pp. 3 + ii + 273 + ccxviii. Indian Forest Memoirs. Vol. i, No. 1. Calcutta, 1909. Price 4s.

The frequency with which enquiries are made regarding the suitability of Indian woods for specific purposes, and the difficulty often experienced in obtaining such information, have induced the author to put together in convenient form a mass of data, the collection of which has occupied many years. No less than 554 species are dealt with.

The work is divided into two parts, the first of which treats of the various uses of Indian woods; in the second is given a descriptive list of the chief Indian woods. Here the scientific name of each species is given, the natural order, synonym, English and vernacular names, habitat, a brief description of the tree and wood, the weight per cubic foot, strength, and chief uses.

The indices occupy nearly half the work; first, there is a general subject index, then one to English and trade names, and finally a most comprehensive one to vernacular names.

The whole work forms a valuable epitome on the economy of Indian timbers, and cannot fail to be of service to all interested in such.

CURRENT LITERATURE.

I.—General Subject.

Banks, Nathan.—Directions for Collecting and Preserving Insects. U.S. Nat. Mus., Bull. 67, 1909, pp. xiii + 135, 1 plt. and 188 figs.

A very useful publication.

Felt, E. P.—Insects and Legislation. Journ. Econ. Entom., 1909, vol. ii, pp. 342-345.

Gossard, H. A.—Relation of Insects to Human Welfare. Journ. Econ. Entom., 1909, vol. ii, pp. 313-324.

Sanderson, E. D.—Publications of the Station Entomologist. Journ. Econ. Entom., 1909, vol. ii, pp. 268-277.

II.—Anatomy, Physiology, and Development.

Hegner, R. W.—Origin and early History of the Germ-Cells in some Chrysomelid Beetles. Journ. Morph., 1909, vol. xx, pp. 231-295, 4 plts.

Oudemans, A. C.—Über den systematischen Wert der weiblichen Genitalorgane bei den Suctoria. Zool. Anz., 1909, Bd. xxxiv, pp. 730-736, 11 figs.

Solowiow, P.—Zum Bau des Verschlussapparates des Stigmen bei den Insekten. Zool. Anz., 1909, Bd. xxxiv, pp. 705-711.

III.—General and Systematic Biology, and Geographical Distribution.

Blaisdell, F. E.—A Monographic Revision of the Coleoptera belonging to the Tenebrionide Tribe Eleodiini inhabiting the United States, Lower California, and adjacent Islands. U.S. Nat. Mus., Bull. 63, 1909, pp. xi + 524, 13 plts.

Cameron, P.—On some Undescribed *Ichneumonidae and Braconidae*, reared by Mr. T. Bambrigge Fletcher, R.N., from Ceylonese Lepidoptera (*Pterophidae*). Spolia Zeylanica, 1909, vol. vi, pp. 40-43.

Cockerell, T. D. A.—A new Coccid of the genus *Eriococcus*. Proc. Ent. Soc. Wash., 1909, pp. 167, 168.

Cockerell, T. D. A.—A new Braconid of the genus *Elasmosoma*. Ibid., pp. 168, 169.

Cockerell, T. D. A., and Rohwer, S. A.—A new gall-making Coccid on *Atriplex*. Ibid., pp. 169, 170.

Davidson, W. M.—Notes on *Aphididae* collected in the vicinity of Stanford University. Journ. Econ. Entom., 1909, vol. ii, pp. 299-305.

Felt, E. P.—Additional rearings in *Cecidomyiidae*. Journ. Econ. Entom., 1909, vol. ii, pp. 268-293.

Many new species briefly diagnosed.

Fletcher, T. B.—The Plume-Moths of Ceylon. Spolia Zeylanica, 1909, vol. vi, pp. 1-39, plts. A-F and map.

Gestro, R.—Coleopterorum Catalogus. Pars. 1. *Rhysodidae*. Pp. 1-11. Berlin: W. Junk, 1909.

Gillette, C. P.—Plant Louse Notes, family *Aphididae*. Journ. Econ. Entom., 1909, vol. ii, pp. 351-357, 16 figs.

Howard, C. W.—A New Species of *Haemaphysalis* from East Africa. Ann. Transv. Mus., 1909, vol. i, pp. 219-223, 10 figs.

H. africana, n.sp. has been found on the bird known as Burchell's Coucal, *Centropus burchelli*. All the four forms—males, females, nymphs, and larvae—were found on the host at the same time.

Howard, C. W.—A Feeding Habit of some Lourenço Marques Butterflies. Ann. Transv. Mus., 1909, vol. i, pp. 224, 225.

The author records a small butterfly, *Crenis boisduvali* (Wallengren), puncturing, by means of its proboscis, the fruit of the apple and quince. Two other species are mentioned as attacking oranges and naartjes, whilst three species of moths common in the Transvaal have a similar habit of puncturing fruit, all of which cases serve to throw discredit upon the old theory that the Lepidoptera are, as a rule, destructive only in the larval stage.

Howard, C. W.—A Note on the Copulation of Ticks. Ann. Transv. Mus., 1909, vol. i, p. 225.

Jackson, A. D.—A Study of Ohio Forms of the Genus *Lepidocyrtus*. Ohio Nat., 1909, vol. ix, pp. 525-538, 22 figs.

The author gives some interesting notes on the genus generally and describes two new species, *L. sanguineus* and *L. luteus*.

Marchal, P.—Contribution à l'étude des Coccides de l'Afrique occidentale. Mem. Soc. Zool. France, 1909, T. xxii, pp. 165-182, plts. 9, 10, and 8 figs.

Needham, J. G.—Studies of Aquatic Insects. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 71-75, 1 plt. and 1 fig.

Osgood, W. H.—Revision of the Mice of the American Genus *Peromyscus*. U.S. Dept. Agric., Bur. of Biol. Sur., No. 28, 1909, pp. v + 285, 8 plts.

Patton, W. S.—The Life-Cycle of a species of *Crithidia* parasitic in the intestinal tracts of *Tabanus hilarius* and *Tabanus* sp.? Archiv. für Protistenkunde, 1909, Bd. xv, pp. 333-362, plt. 30, and 2 figs.

Quaintance, A. L.—A new Genus of *Aleyrodidae*, with remarks on *A. nubifera*, Berger, and *A. citri*, Riley and Howard. U.S. Dept. Agric., Bur. of Entom., Tech. Ser. No. 12, pt. ix, 1909, pp. 169-174, 2 figs.

This is the *Aleyrodes perseae* described by this author in 1900. It is now removed to a new genus named *Paraleyrodes*.

Severin, H. C. and H. H. P.—A Preliminary List of the Coccidae of Wisconsin. Journ. Econ. Entom., 1909, vol. ii, pp. 296-298.

Swaine, J. M.—Catalogue of the described *Scolytidae* of America, North of Mexico. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 76-159, plts. 3-17.

Swierstra, C. J.—Check List of the Lepidoptera-Rhopalocera of the Transvaal, with Notes on some of the Species. Ann. Transv. Mus., 1909, vol. i, pp. 235-299.

Wilson, H. F.—Some New Records of *Aphididae* in North America. Journ. Econ. Entom., 1909, vol. ii, pp. 346-350, 2 figs.

Records the finding of *Pentalonia nigronervosa*, Coq., on bananas, *Aphis angelicae*, Koch, on angelica and ivy, and *Drepanosiphum platanoides* on maple.

IV.—Agriculture and Horticulture.

Ballou, H. A.—The Scarabee of the Sweet Potato. W.I. Bull., 1909, vol. x, pp. 180-196, 10 figs.

Carpenter, G. H.—Injurious Insects and other Animals observed in Ireland during the year 1908. Econ. Proc. Roy. Dublin Soc., 1909, vol. i, pp. 589-611, plts. lv-lix, and 8 figs.

Amongst the many interesting animals dealt with in this report mention must be made of the accounts of *Dascillus cervinus* (Linn.), the Silky Beetle, the larvae of which have been thought to be injurious to young oat-plants and grasses, and a new bulb mite *Histiogaster corticalis* (Michael).

Cherry, T.—The Victorian Potato Industry. The Inter-State Conference and the Irish Blight. Journ. Vict. Dept. Agric., 1909, vol. vii, pp. 593-602, 8 figs.

Chittenden, F. H.—Miscellaneous Notes on Truck-crop Insects. U.S. Dept. Agric., Bur. of Entom., Bull. No. 66, pt. vii, 1909, pp. 93-97.

Felt, E. P.—24th Report of the State Entomologist, 1908. N.Y. State Mus., Mus. Bull. 134, Albany, 1909, pp. 5-70, 1 plt. and 21 figs.

Fernald, H. T.—A Parasite of the Asparagus Beetle. Journ. Econ. Entom., 1909, vol. ii, pp. 278, 279.

Fernald, H. T.—A New Treatment for Wireworms. Journ. Econ. Entom., 1909, vol. ii, pp. 279, 280.

Foster, S. W.—Additional Observations on the Lesser Apple Worm. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. iii, 1909, pp. 45-50, plt. iii.

Freeman, E. M., and E. C. Johnson.—The Loose Smuts of Barley and Wheat. U.S. Dept. Agric., Bur. Plant Indus., Bull. No. 152, 1909, pp. 1-48, plts. i-vi.

Froggatt, W. W.—Report on Parasitic and Injurious Insects. N.S.W. Dept. Agric., Sydney, 1909, pp. v + 115, 22 plts.

This interesting report consists of three parts, the first is a general report upon the commercial value of introduced parasites to deal with insects that are pests, and also treats of the range and spread of Fruit-flies and the methods adopted in other countries to check them, and the value of parasites in exterminating them. It is somewhat gossipy, and loosely written.

Part II. consists of notes on parasites or insects that have been introduced from foreign countries to check or exterminate injurious insects, whilst Part III., by far the most important one, gives an account of the *Trypetidae*, treating of their habits, range, and suggestions for destroying them.

The following are described as new: *Dacus frenchi* and *D. ornatissimus*, from New Caledonia; *D. curvipennis*, from Fiji; and *Ceratitis striata*, from Ceylon.

Goodwin, W. H.—The Raspberry Byturus. *Byturus unicolor.* Ohio Agric. Exp. Stat., Bull. No. 202, 1909, pp. 173-186, 8 figs.

Gunn, D.—Silkworm Culture in the Transvaal. Transv. Agric. Journ., 1909, vol. vii, pp. 662-673, 9 figs.

Halsted, B. D.—Report of the Botanist. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 181-301, 33 plts.

Herrick, G. W.—Notes on Mites affecting Chickens. Journ. Econ. Entom., 1909, vol. ii, pp. 341, 342.

Johnston, J. R.—The Bud-Rot of the Cocoanut Palm. U.S. Dept. Agric., Bur. Plant Indus., Circ. No. 36, 1909, pp. 1-5.

Kirk, T. W.—Report of the Biologist. 16th Ann. Rpt. N.Z. Dept. Agric., 1908, pp. 97-162, 24 plts., and 9 text figs.

This Report chronicles under various headings the excellent work that is being carried out by the Chief of the Division of Biology and Horticulture.

The chief points to which we would draw attention are the accounts of Diseases of garden plants, Diseases of fruit trees, and Diseases of potatoes. There is also a well-illustrated account of the "Gum-tree Blight" due to *Eriococcus coriaceus,* Maskell, and one on Eelworms.

Kirk, T. W.—Diseases of Turnips. N.Z. Dept. Agric., Div. of Biol., Bull. No. 14, 1909, pp. 1-4, 5 figs.

Kirk, T. W.—Fruit Flies. Ibid., Bull. No. 22, 1909, pp. 1-18, 8 figs.

Kirk, T. W., and A. H. Cockayne.—The Gum-tree Scale. N.Z. Dept. Agric. Div. of Biol., Bull. No. 13, 1909, pp. 1-8, 7 plts, 4 figs.

Kirk, T. W., and A. H. Cockayne.—Eelworms. Ibid., Bull. No. 20, 1909, pp. 1-7, 9 figs.

Kirk, T. W., and A. H. Cockayne.—Parasitic Plants. Ibid., Bull. No. 21, 1909, pp. 1-4, 4 figs.

Kirk, T. W., and A. H. Cockayne.—Bacterial Diseases of Plants. Ibid., Bull. No. 23, 1909, pp. 1-8, 1 plt.

Lefroy, H. Maxwell.—The Cultivation of Shellac as an Agricultural product. Agric. Journ. Ind., 1909, vol. iv, pp. 258-270, plts. xxiv-xxx.

Lefroy, H. M.—Thrips in Tea. Ibid., pp. 282-290, plt. xxxi.

Lipman, J. G.—Azotobacter Studies. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 135-147.

Longman, Sibyl.—The Dry Rot of Potatoes. Journ. Linn. Soc. (Botany), 1909, vol. xxxix, pp. 120-129, plt. 10.

Lounsbury, Chas. P.—Report of the Government Entomologist for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 55-70.

Lounsbury, Chas. P.—Third Annual Report of the Committee of Control of the South African Central Locust Bureau. Pp. iv + 68, Cape Town, 1909.

A record of valuable work of vast import to South Africa.

Lounsbury, Chas. P.—Dry Rot of the Potato. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 42-48, 3 figs.

This disease, due to *Nectria solani,* has been brought into prominence in South Africa owing to the Transvaal authorities rejecting any consignment in which one per cent. of the tubers is infected.

The author gives various preventive methods, but nothing is said as to eradicating the disease or destroying the spores.

Lounsbury, Chas. P.—Prune Rust. A leaf disease of Prune, Peach, and Apricot trees. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 98-103, 3 figs.

MacDougall, R. S.—The Genus *Chermes* in its Relation to Forestry. Journ. Bd. Agric., 1909, vol. xvi, pp. 441-453, 2 plts. and 2 figs.

Morrill, A. W., and W. W. Yothers.—Preparations for Winter Fumigation for the Citrus White Fly. U.S. Dept. Agric., Bur. of Entom., Circ. No. 111, 1909, pp. 1-12, 4 figs.

Moulton, Dudley.—The Pear Thrips. U.S. Dept. Agric., Bur. of Entom., Bull. No. 68, pt. i, revised, 1909, pp. 1-16, plts. i, ii, and 8 text figs.

Moulton, Dudley.—The Pear Thrips and its control. U.S. Dept. Agric., Bur. of Entom., Bull. No. 80, pt. iv, 1909, pp. 51-66, plts. iv-vi, 5 figs.

Newell, W., and A. H. Rosenfeld.—Some Common Insects injurious to Truck Crops. State Crop Pest Comms. Louisiana, Circ. No. 27, 1909, pp. 93-131, 21 figs.

Newell, W.—The Fumigation of Nursery Stock with Hydrocyanic Acid Gas. State Crop Pest Comms. Louisiana, Circ. No. 29, 1909, pp. 139-150, 5 figs.

Newell, Wilmon.—Measures suggested against the Argentine Ant as a Household Pest. Journ. Econ. Entom., 1909, vol. ii, pp. 324-332, plt. 8, 1 fig.

Phillips, J. L.—Fumigation, Dosage and Time of Exposure. Journ. Econ. Entom., 1909, vol. ii, pp. 280-283.

Popenhoe, C. H.—The Colorado Potato Beetle in Virginia in 1908. U.S. Dept. Agric., Bur. of Entom., Bull. No. 82, pt. 1, 1909, pp. 1-8, plts. 1 and 2.

Poppins, B.—Remarks on an injurious Capsid in the Cocoa Plantations of West Africa. Entom. Mon. Mag., 1909, p. 162.

Reh, L.—Die Schildlaus-Krankheit der Kokospalmen. Tropenpflanzer, 1909, No. 10, pp. 1-6.

Robertson, W.—Report of the Director, Veterinary Laboratory, Grahamstown for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 35-39.

Russell, H. M.—The Greenhouse Thrips. U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, pt. vi, 1909, pp. 43-60, 3 figs.

Gives an account of the life-history of *Heliothrips haemorrhoidalis*, Bouché.

Sargeant, F. P.—Agricultural and Horticultural Preparations. Pp. 46. London: The Pharmaceutical Press, 1909.

Schultz, H. F.—*Brassolis isthmia,* a Lepidopterous Insect highly injurious to Cocoanut Culture in the Panama Canal Zone. Proc. Entom. Soc. Wash., 1909, vol. x, p. 164.

Scott, W. M.—Lime-sulphur mixtures for the Summer Spraying of Orchards. U.S. Dept. Agric., Bur. of Plant Ind., Circ. No. 27, 1909, pp. 1-17.

Selby, A. D., and T. F. Manns.—Studies in Diseases of Cereals and Grasses. Ohio Agric. Exp. Stat., Bull. No. 203, 1909, pp. 187-236, plts. i-xiv, and 7 figs.

Treats of a new Anthracnose disease of certain cereals and grasses due to *Colletotrichum cereale,* n.sp., and the fungus of wheat scab, *Fusarium roseum,* Lk.

Smith, John B.—Report of the Entomologist. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 305-378, 9 figs.

Smith, John B.—Report on the Mosquito Work for 1908. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 381-415.

Swenk, Myron H.—*Elodes* as an enemy of planted Grain. Journ. Econ. Entom., 1909, vol. ii, pp. 332-336, plts. 9, 10.

Thornton, R. W.—Relative Rust-resistance and yield of various varieties of Wheat, Oats, and Barley. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 65-73.

Thornton, R. W.—Relative Rust-resistance and yield of various varieties of Wheat and Oats. Ibid, pp. 74-76.

Tucker, E. S.—New Breeding Records of the Coffee-bean Weevil (*Araecerus fasciculatus,* De Geer). U.S. Dept. Agric., Bur. of Entom., Bull. No. 64, pt. viii, 1909, pp. 61-64, plt. iii, and 1 fig.

V.—Forestry.

Duchesne, M. C.—Practical English Estate Forestry. Trans. Surv. Inst., 1909, vol. xli, pp. 263-308.

Duchesne, M. C.—The Beech Coccus (*Cryptococcus fagi*). Q. Journ. Fores., 1909, vol. iii, pp. 345-350.

VI.—Fisheries.

Carr, A. M.—The Food and Condition of Fish obtained from the North-East Coast. Rpt. Northumberland Sea Fish. Comm. 1908-09, 1909, pp. 41-50.

Meek, A.—Migrations of Inshore Flat Fish. Rpt. Northumberland Sea Fish. Comm. 1908-09, 1909, pp. 30, 31.

Meek, A.—Migrations of Lobsters. Ibid., pp. 32-35.

Meek, A.—A Proposed Close Season for Crabs. Ibid., pp. 36-38, chart.

Nelson, J.—Studies of Natural Oyster Propagation at Barnegat, 1908. 29th Ann. Rpt. New Jersey Agric. Exp. Stat., 1909, pp. 151-177, plts. i-vi.

VII.—Medicine.

Atkinson, J. M.—A Possible Natural Enemy to the Mosquito. Lancet, 1909 (Sept. 4th), pp. 708-710, 3 figs.

Records *Lispa sinensis*, Schiner, feeding upon the larvae.

Bashford, E. F.—Cancer in Man and Animals. Lancet, 1909 (Sept. 4th), pp. 691-701.

Daniels, C. W.—The Persistence of the Tropical Diseases of Man due to Protozoa. Lancet, 1909 (Aug. 14th), pp. 460, 461.

Herms, W. B.—Medical Entomology, its scope and methods. Journ. Econ. Entom., 1909, vol. ii, pp. 265-268.

Kinghorn, A. & R. E. Montgomery.—On the Flagellates occurring in the intestine of *Glossina palpalis* and in the intestine and proboscis of *Glossina morsitans*. Ann. Trop. Med. and Paras., 1909, vol. iii, pp. 259-276.

Kinghorn, A. & R. E. Montgomery.—Second Report on Human Trypanosomiasis in North-Eastern Rhodesia and Nyasaland. Ibid., pp. 277-309.

Patterson, R. Lloyd.—An Indian Screw Worm. Indian Med. Gaz., 1909, vol. xliv, pp. 374-376, 1 plt.

VIII.—Animal Diseases, etc.

Borthwick, J. D.—Report of the Chief Veterinary Surgeon for the Year 1908. Rpt. Dept. Agr. C. of G.H., 1909, pp. 21-33.

Carpenter, Geo. H., and W. F. Prendergast.—The Warble Flies. Further Experiments as to Life-history and Treatment. Journ. Dept. Agric. and Tech. Instr., Ireland, 1909, vol. ix, pp. 2-13, 1 plt. and 2 figs.

Cleland, J. B.—Streptococcal Granuloma of Lung of a Camel. Journ. Trop. Vet. Sci., 1909, vol. iv, page 133.

Dixon, R. W.—Catarrhal Fever of Sheep-Bluetongue. Agric. Journ. C. of G.H., 1909, vol. xxxiv, pp. 487-491.

Elsey, Stanley.—The Ostrich Industry. The possibility of improving the standard of veld-grown feathers. Agric. Journ. C. of G.H., 1909, vol. xxxv, pp. 312-315.

Evans, G. H., and T. Rennie.—Notes on some Parasites in Burma.—II. Journ. Trop. Vet. Sci., 1909, vol. iv, pp. 134-143, plts. v-viii, and 3 figs.

Gilruth, J. A.—Report of the Chief Veterinarian. 16th Ann. Rpt. N.Z. Dept. Agric. 1908, pp. 163-214, 3 plts.

Amongst the many diseases and parasites mentioned, the following are dealt with at some length: Tuberculosis; Septic Metritis in Cows; Contagious Stomatitis in Lambs and Sheep; Facial Eczema in Sheep; Partial Hernia in Fat Lambs; *Haematopinus* of Sheep; the Sheep Maggot; New growths simulating Tuberculosis lesions due to Cysticerci in Sheep; and Bovine contagious Mammitis.

Hooker, W. A.—Some Host Relations of Ticks. Journ. Econ. Entom, 1909, vol. 2, pp. 251-257.

Lantz, D. E.—The Brown Rat in the United States. U.S. Dept. Agric., Biol. Surv., Bull No. 33, 1909, pp. 1-54, plts i-iii, 4 figs.

A very valuable and practical paper.

Leese, A. S.—Experiments regarding the Natural Transmission of Surra carried out at Mohand in 1908. Journ. Trop. Vet. Sci., 1909, vol. iv, pp. 107-132.

MacDougall, R. S.—Sheep Maggot and Related Flies, their Classification, life-history, and habits. Trans. High. and Agr. Soc. Scot., 1909, pp. 135-174, figs. 17-25.

Montgomery, R. E., and A. Kinghorn.—A Further Report on Trypanosomiasis of Domestic Stock in Northern Rhodesia (North-Eastern Rhodesia). Ann. Trop. Med. and Paras., 1909, vol. iii, pp. 311-374, plts. iii, iv, 1 map.

Piper, S. E.—The Nevada Mouse Plague of 1907-8. U.S. Dept. Agric., Farmers' Bull. 352, 1909, pp. 1-23, 9 figs.

The seriousness of the recent mouse plague in Humboldt Valley, Nevada, may be gathered from the bulletin before us, in which the author points out that at the height of abundance from 8,000 to 12,000 mice were present per acre. Serious losses in hay and root crops was the result, in addition to the death of willows, poplars, etc., in the affected area. The total loss is estimated at about £60,000.

The means taken to eradicate these pests (*Microtus montanus*) were by poisoning with strychnine, irrigation, winter flooding, burning, the use of trained dogs, and the destruction of winter cover.

Shipley, A. E.—The Ectoparasites of the Red Grouse *(Lagopus scoticus)*. Proc. Zool. Soc. Lond., 1909, pp. 309-334, plts. xxxv-xlvii.

Shipley, A. E.—The Thread-Worms (Nematoda) of the Red Grouse *(Lagopus scoticus)*. Proc. Zool. Soc. Lond., 1909, pp. 335-350, plts. xlviii-lv.

Shipley, A. E.—The Tape-Worms (Cestoda) of the Red Grouse *(Lagopus scoticus)*. Proc. Zool. Soc Lond., 1909, pp. 351-363, plts. lvi-lx.

Shipley, A. E.—Internal Parasites of Birds Allied to the Grouse. Proc. Zool. Soc. Lond., 1909, pp. 363-368.

Whatever facts may be gleaned from the Grouse Disease Inquiry bearing directly on the cause and nature of the disease, a wealth of material has been obtained in the form of ecto- and endoparasites and these have fortunately been described by Dr. Shipley.

The four beautifully illustrated memoirs before us contain descriptions of the external features and internal structure of many most interesting parasites. Thus the *Goniodes tetraonis*, Denny, is described at great length and very beautifully illustrated. Two carefully executed figures illustrate the description of the Grouse-fly, *Ornithomyia lagopodis*, Sharp. The structure of *Trichostrongylus pergracilis* (Cobbold) is described in detail and an interesting account given of the life-history.

Incidently Dr. Shipley raises a large number of most interesting problems to the economic biologist, evidencing how very thoroughly the work has been done, not the least interesting of these is the general discussion on the relation of ectoparasites to the endoparasites of the grouse.

Theiler, A.—Diseases, Ticks, and their eradication. Trans. Agric. Journ., 1909, vol. vii, pp. 685-699.

Watkins-Pitchford, H.—Dipping and Tick-Destroying Agents. Natal Agric. Journ., 1909, vol. xii, pp. 436-459, 2 plts., and 2 text figs.

ERRATUM.

In the figure on p. 63 illustrating Dr. Shipley's paper "On the Relation of Certain Cestode and Nematode Parasites to Bacterial Disease," for "7 specimens of *Trichostrongylus pergracilis* (Cobbold)" read "7 specimens of *Cystidicola farionis*, Fischer."

PROCEEDINGS

OF THE

ASSOCIATION OF ECONOMIC BIOLOGISTS.

ANNUAL MEETING, July 13-15, 1909.

TUESDAY, JULY 13TH, 1909.

The Annual Meeting was held in the School of Forestry, Oxford.

The President, Dr. A. E. Shipley, F.R.S., occupied the chair, and there was a large attendance.

The minutes of the previous meeting were read, confirmed, and signed.

Mr. Collinge read the following Annual Report:—

FOURTH ANNUAL REPORT.

In presenting their Fourth Annual Report (covering the period from January, 1908, to July, 1909), your Council are pleased to report a continued steady growth in the numerical strength of the Association.

The total number of members of all classes on June 30th, 1909, was 132, namely:—

Honorary Members	8
Ordinary	107
Associate	17
	132

There are also eight candidates awaiting election.

A successful meeting was held at University College, London, on April 15th, 1908, and a two-days' meeting at Edinburgh, on July 28th and 29th.

A fourth part of the "Proceedings" of the Association has been issued, bringing to a conclusion volume 1.

Your Council have decided to cease this publication as at present published, and arrangements have been made whereby all future members, and all members contributing £1 1s. 0d. per year to the Association funds, will receive free the "Journal of Economic Biology," including the "Proceedings." Other members subscribing 10s. 6d. will receive the "Proceedings" only.

The total receipts up to June 30th, 1909, amounted to £31 16s. 9d., whilst the total expenditure for the same period amounted to £10 0s. 0d., leaving a balance in the hands of the Honorary Treasurer of £86 19s. 1d.

There is also a balance of £50 1s. 0d. for outstanding subscriptions.

Your Council have received and accepted an invitation to meet at the University of Manchester in July, 1910.

In accordance with Law 12, the Council nominated the following as the Officers of the Association for the year 1909-1910. No further nominations having been received these were put to the meeting and declared elected.

President:

A. E. SHIPLEY, M.A., Hon.D.Sc., F.R.S.

Vice-Presidents:

SIR PATRICK MANSON, K.C.M.G., LL.D., M.D., F.R.S.
PROFESSOR E. B. POULTON, M.A., D.Sc., F.R.S.
FRED. V. THEOBALD, M.A.

Council:

COLONEL A. W. ALCOCK, M.B., LL.D., F.R.S.
W. G. FREEMAN, B.Sc., A.R.C.S., F.L.S.
R. STEWART MACDOUGALL, M.A., D.Sc., F.R.S.E.
FRANCIS H. A. MARSHALL, M.A., D.Sc., F.R.S.E.
ROBERT NEWSTEAD, M.Sc., A.L.S., F.E.S.
PROFESSOR RONALD ROSS, C.B., F.R.C.S., F.R.S.
FRASER STORY, F.R.S.E.
CECIL WARBURTON, M.A.

Hon. Treasurer:

HERBERT STONE, F.L.S.

Hon. Secretaries:

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

The President explained that Dr. Gordon Hewitt's name had been withdrawn as one of the Honorary Secretaries owing to his having been appointed Government Entomologist to Canada, an appointment upon which he had the hearty congratulations of the Association and the best wishes of its members.

The following alterations in the Laws were then read.

In accordance with Law 18, the Council propose the following alterations in the Laws:—

LAW 4. Members shall pay an Annual Subscription of £1 1s., due in advance, on the first January in each year, or a Composition Fee of £10 10s. All Ordinary Members on election shall pay an Entrance Fee of 10s. 6d.

Members subscribing £1 1s. per year receive free (from January, 1910) the "Journal of Economic Biology."

Those members elected prior to June, 1909, who subscribe 10s. 6d. will receive the "Proceedings" only.

LAW 12. "A General Secretary" *to read* "two Honorary Secretaries," and such other changes in the Laws as to bring them into conformity with this.

No amendments having been received the propositions were put to the meeting and declared carried.

The President, Dr. A. E. Shipley, F.R.S., read a paper on "The Relation of Certain Cestode and Nematode Parasites to Bacterial Disease."[1] He argued that the piercing of the wall of the alimentary canal by parasites carries with it bacterial infection. In the case of the "disease" of Grouse, the caecum is crowded with the thread-worms *Trichostrongylus pergracilis,* and the walls of the caecum become very thin. The anterior ends of the parasites pierce the walls of the alimentary canal, and this is followed by an intrusion of bacteria into the submucous layers. It is found that there is a definite relation between the number of worms in the alimentary canal and the number of bacteria in the body of the host. This perforation of the intestinal wall and subsequent invasion of the lesions by bacilli is of importance in such diseases as peritonitis and appendicitis. Such worms as *Oxyuris,* etc., are frequently associated with peritonitis and other entozoa with appendicitis. He strongly advocated the use of Vermifuges, which are used less than heretofore, and in this he was supported by Prof. Osler in the discussion which followed.

Mr. E. P. Jepson communicated the results of his experiments in the breeding of *Musca domestica* during the winter under

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 61-71.

definitely controlled conditions.[1] In February he reared house flies occurring in the warm college bakehouse on moist germinating bread, and the time of development, at an average temperature of about 70° F., was three weeks.

Mr. C. Warburton gave an account of his experiments on the life-histories of Human Pediculi. By feeding the developing and mature lice on the back of the hand two or three times per day he found that the female of *Pediculus vestimenti* laid 124 eggs in 25 days. The eggs began to hatch in 8 days and continued to do so for about a month. The larva moulted three times and became an imago in 11 days. He found that they feed immediately after hatching. Although great difficulty was experienced in breeding this species still greater trouble was encountered in breeding *P. cervicalis* (*P. capilis*). A single female deposited 48 eggs, which hatched in 17-18 days, the first moult took place a week later, and the later stages of the life history were all correspondingly lengthened compared with those of *P. vestimenti.*

Mr. Walter E. Collinge described the part played by the Collembola or "Springtails" in economic entomology.[2] These minute insects have not been regarded as being of economic importance until recently, and the author showed by a series of observations which he had made, and by adducing the evidence of other observers, that a considerable number of species are injurious to developing seeds, bulbs, orchids, and other plants.

WEDNESDAY, JULY 14TH, 1909.

Mr. A. D. Darbishire gave an account of the actual and possible application of recent discoveries in heredity to economic problems. Of the former the most important is the discovery by Prof. Biffen of a variety of wheat that is immune to the rust fungus. Mr. Darbishire described the general principles of Mendelism and the importance of the discovery of the segregation of dominant and recessive characters: especially the breeding time of the recessives. This is important inasmuch as the crossing of an organism having a resistant character with one having a susceptible character the offspring will be resistant according as this character is dominant or recessive, the latter character being isolated more speedily. He dealt with the importance of such a case where the two "characters" are—the presence of a character in the one and the absence of that character

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 78-82.

[2] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 83-86.

in the other case. One may be able to increase the saccharine contents of such a vegetable as the pea by the application of this discovery, *i.e.*, by the selection of the absorptive character which is different in round and wrinkled peas.

A number of observations which the author had made tend to show that to some extent the character of "the resistance to the attacks of the beetle *Bruchus*" may possibly be dealt with according to Mendelian principles. A number of examples of the results of breeding experiments with peas were shown.

Mr. S. A. Neave communicated some notes on "The distribution and habits of *Glossina palpalis*."[1] The author had made these observations in the Congo Free State in 1907 and in North East Rhodesia in 1908. It would appear that the high plateau country which forms the watershed between the basins of the Congo and Zambesi rivers forms a barrier against the southward extension of the distribution of the fly. In the Katanga region of the Congo Free State *G. palpalis* was everywhere accompanied by Butterflies and other insects, which zoologists associate with the faunal region of the tropical West Coast. He was of the opinion that on the whole this species of Tse-tse will not be found to occur in the Zambezi basin, an important fact in view of the possibility of the spread of Sleeping Sickness into South Africa entertained by some authorities.

Mr. Geoffrey Smith gave an account of some observations which he had made in co-operation with Prof. Dreyer on two bacteria that are always found upon the outside of the shore crab, *Carcinus malvas,* and which are always to be obtained from the blood of dying or recently dead crabs. Both bacteria when grown as pure cultures in fish produce a powerful toxin which kills healthy crabs almost instantaneously when injected into them. A toxin can be filtered from the cultures, which is destroyed by heating for half-an-hour at 50° C. If, however, the unfiltered culture be heated to 60° C. and upwards for more than an hour, its toxic properties are not destroyed. There appears to be therefore two substances, one of which does not get into the filtrate and which is not destroyed at higher temperatures. This substance may play a part in the dangerous qualities of stale crustacea as food. With regard to the resistance of the crab against these bacteria, strong injections of the cultures are at once fatal, but if the bacteria are washed and injected in very dilute quantities the crabs very frequently survive the injection. Showing that the bacteria have been destroyed by phagocytosis or by some other means. Similar bacteria have been isolated from the outside

[1] Paper published *in extenso* in the Journal of Economic Biology, 1909, vol. iv, pp. 109-113.

of the freshwater crayfish, but they do not exhibit such marked toxic characters as the foregoing. Hofer, of Munich, considers the crayfish plague to be due to a special bacillus which he has found in plague-stricken areas. Investigations are being conducted which are intended to discover the relation of this plague bacillus to other poisonous bacteria living on the outside of crabs, lobsters, and crayfish.

Prof. G. H. F. Nuttall and Dr. S. Hadwen gave an account of their discovery of a successful curative treatment of Piroplasmosis. The Piroplasma, which is communicated by ticks to dogs in the one case and cattle, where it causes "Red-water Fever," in the other occurs in red blood corpuscles. In several cases 80 to 85 per cent. of corpuscles are infected, and the escape of the parasites during their multiplication into the blood gives rise to the characteristic Haemoglobinurea. The life cycle, which was described, bears a definite relation to the treatment as the double pyriform and large rounded forms of the parasite are dominant in the blood. It was found that if Trypanblan was injected subcutaneously or intravenously all the pyriform parasites disappeared and the remainder of the parasites degenerated two hours later. The animals (dogs) showed no symptoms. After about 10 or 12 days the parasites appear again in very small numbers, but the animals appear to be quite well and the parasites disappear. One injection was sufficient, and practically all the dogs injected were cured, all the controls (uninjected) dying.

An 100 per cent. mortality, which occurs in this disease in dogs, was converted into an 80 per cent. recovery. This drug has the same effect on the Piroplasma of cattle; it is destroyed after about two hours, but further investigation is necessary in the case of this disease before the drug can be put to practical use. No curative drug has yet been found in the case of East Coast Fever, which is due to the so-called *Piroplasma parvum,* but it is not recognised as a *Piroplasma.*

Prof. E. B. Poulton exhibited a large series of Predaceous Insects, together with their prey. They were chiefly Diptera belonging to the families of *Asilidae* and *Empidae.*

Prof. W. Somerville also exhibited a large number of parasitic fungi.

THURSDAY, JULY 15TH, 1909.

Dr. C. Gordon Hewitt gave a further account of his investigations of the large larch sawfly *Nematus erichsoni.* After briefly describing the previous work and nature of attack an account of the

natural enemies was given. It is found that the ichneumon parasite in the larvae of the sawfly is increasing in numbers. In 1908 nearly 6 per cent. of the cocoons collected from different plantations in the Lake District were parasitised; this year over 15 per cent. of cocoons from the same plantations were parasitised. An ichneumon *Microcryphis labralis,* which is probably a hyper-parasite has been discovered. About 10 per cent. of the cocoons were attacked during the past winter by a fungal parasite, a species of *Cordyceps,* the mode of infection which is believed to be terrestrial by the author. The field vole, *Microtus agrestis,* is destroying an increasing number of pupating larvae. The protection and winter feeding of useful insectivorous birds has been undertaken, and in 1908 33 per cent. of the nest boxes were occupied. In spite of these natural enemies and the success of eradicative measures in the younger plantations, the author expressed the opinion that the results of this attack, which was spreading, would be of a very grave character, and Professor Somerville, in the discussion, regarded the outlook with great misgivings in view of the fatal results of the attack in Canada in 1890-1895, when practically all the eastern larches were destroyed.

Mr. A. J. Grove gave an account of the anatomy of the rose aphid, *Siphonophora rosarum,* especial attention being given to the character and method of working of the greatly modified mouth-parts.

A paper by Mr. Cecil H. Hooper on the blossoming and pollen of our hardy cultivated plants was communicated. The object of Mr. Hooper's investigations has been to obtain some information on the injury done to blossoms by frost and to ascertain the order of flowering of different varieties for the purpose of cross fertilisation in order to group those that flower at the same time. It is convenient for spraying to have varieties at the same stage of flowering near together. The paper was illustrated by numerous photographs.

On the afternoon of July 14th a very enjoyable excursion was made to Tubney and Bagley Woods, under the leadership of Prof. Somerville and Mr. Grosvenor.

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TO CONTRIBUTORS.

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