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HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS

DIPTERA

PIPUNCULIDAE

By

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DIPTERA

Family PIPUNCULIDAE

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Ovaries of *Verrallia villosa* von Roser ♀.

R. L. COE.

DIPTERA

Family PIPUNCULIDAE

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Characteristics

Flies of the family Pipunculidae may be recognized by their strikingly large eyes, semiglobular or nearly globular and extremely mobile head, predominantly obscure coloration, and by their habit of hovering inconspicuously in low herbage, in hedgerows or among the foliage of various trees. Their wing venation (figs. 1, 14–19, 23) most closely approaches that of the Syrphidae. They are mainly quite small, with an average wing length of around 4 mm. ; the smallest British species belong to the genus *Chalarus* (range of wing lengths, 2·5–4·0 mm.), while the largest is the comparative "giant" of the family in Britain, *Nephrocerus flavicornis* Zetterstedt (range of wing length 7–9 mm.).

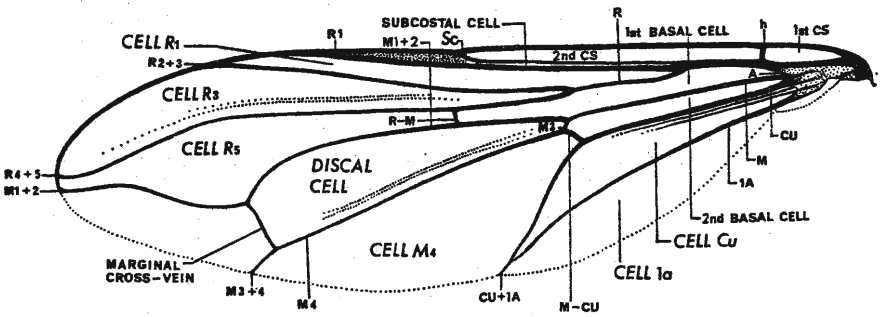


Fig. 1.—Wing of a Pipunculid, showing notation of veins. (*h*, humeral cross-vein ; *1st CS*, first costal cell ; *2nd CS*, second costal cell ; *Sc*, subcostal vein ; *1A*, first anal vein ; *a*, arculus.)

Aczel (1954 : 78) considers that the Pipunculidae are closely related to the Dolichopodidae, Platypezidae and Syrphidae, these four families composing the series Aschiza in his division Campylopyga of the Diptera.

Pipunculidae may be readily distinguished from the Dolichopodidae by the disproportionately long legs of the latter, which also differ in having the discal cell confluent with the second basal cell and in the head usually being flatter; from the Platypezidae, by the latter having the arista terminal instead of dorsal ; and from the Syrphidae by the latter having wing cell R5 (first posterior) closed and a spurious vein (really a thickening of the wing membrane) passing through the first basal cell and R5. In addition, the male and female genital characters clearly distinguish the Pipunculidae from other Dipterous families. There are, of course, many less obvious differences.

Taxonomically, many of the British species are difficult to distinguish from one another, owing to their very similar structure and coloration. Besides, sexual dimorphism sometimes makes it difficult to associate with certainty the sexes, and to aggravate this problem mated pairs of the majority of species are only rarely taken in the field. Such dimorphism may take the form in the female of strikingly enlarged front eye facets, the third antennal segment being more pointed or rostrate, claws and pulvilli larger, general coloration paler, and the wings shorter and blunter with consequently different venational ratios from the male. It is interesting to note that, while the comparative blunting or pointing of the third antennal segment in Pipunculidae has been used as a specific key character by some authors for certain of the world fauna, *e.g.* Hardy (1943) for the Nearctic species, this feature is too closely graduated to be of practical use in keying our British species.

Since Verrall (1901 : 60–126) published his fascinating account of the Pipunculidae in his *British Flies* series, only a few papers by Collin and others dealing with our fauna have appeared. Verrall recognized 32 British species, and this number is now more than doubled, 77 species being keyed in the present work ; this slightly exceeds the figure given by Verrall for the entire world fauna of *Pipunculus* (s. lat.) known at that time. It is extremely probable that in this difficult and little studied family more species will be found to occur in Britain and indeed new species have been included in the present keys, a practice not usually followed in this series of *Handbooks*.

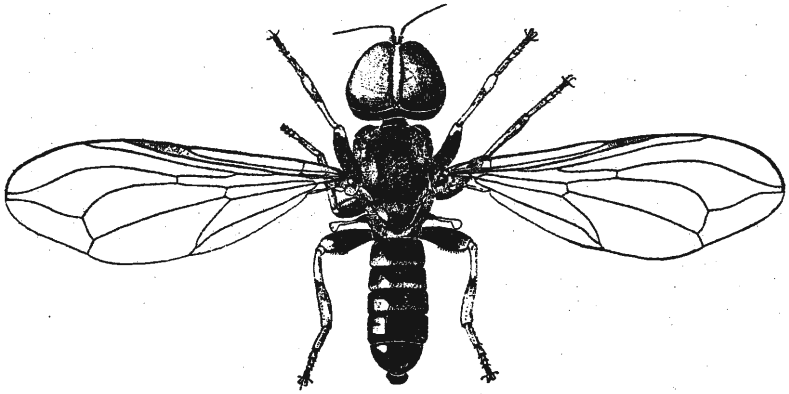


FIG. 1A.—*Pipunculus thomsoni* Becker.

LIFE-HISTORY

Pipunculidae are in their larval instars endoparasites in the abdomens of members of various families of Homoptera, and as such are undoubtedly in many instances of considerable economic importance in the control of Homopterous crop pests. Their biologies are at present very little known. Indeed, our present knowledge owes much to economic studies, particularly of the Pipunculidae parasitizing the sugarcane-hopper (*Perkinsiella saccharicida* Kirkaldy) of Hawaii (Muir, 1921 ; Perkins, 1905, 1906, 1907, Swezey, 1936 ; F. X. Williams, 1918, 1931), and several species of cane-hopper in Mauritius (J. R. Williams, 1957). Other Pipunculidae studied in the economic field are those species attacking the beet-hoppers of North America (Hartung &

Severin, 1915 ; Knowlton, 1932, 1937 ; Knowlton & Bowen, 1930 ; Severin, 1924, 1933 ; Stahl, 1920), the mango-hoppers of India (Subramaniam, 1922), and the rice-hoppers of Japan (Esaki & Hashimoto, 1932, 1934, 1935, 1936, 1938 ; Koizumi, 1959, 1960). Hardy (1964 : 304) gives the interesting information that Pipunculidae are now apparently completely absent from the Hawaiian sugar-fields, having been so for more than the past two decades, and he adds that the sugarcane-hopper only occurs in small numbers and no longer constitutes a serious pest.

In the above-quoted economic studies, the degree of parasitism of leafhoppers by Pipunculidae ranges from nil to as high as 60 per cent. in the case of the beet-hopper (*Eutettix tenellus* Baker) in Utah (Hardy, 1943 : 17) and 65 per cent. in the case of the rice-hopper (*Nephotettix bipunctatus cincticeps* Uhler) in Japan (Esaki & Hashimoto, 1936 : 465). F. X. Williams (1918 : 191), in connection with his study of the sugarcane-hopper of Hawaii, states that at first it appeared that the male hoppers were more often "pipunculized" than the females, but this was undoubtedly because parasitism is more apparent in the male, the abdomen of the gravid female Homopteron being swollen in any case. He also suggests that percentages of leafhopper parasitism are probably underestimated owing to the difficulty of distinguishing small pipunculid maggots. Authors are generally in agreement that adult *male* Homoptera containing a mature pipunculid larva may easily be recognized by their swollen appearance and sluggish behaviour. Perkins (1905 : 126) suggests that when one is familiar with the species of leafhopper involved it is not difficult to detect parasitized individuals of either sex. He was probably the first investigator to notice that in some green hoppers containing a large pipunculid maggot the colour of the host changes to a sickly yellow. Esaki & Hashimoto (1934 : 375, 1935 : 264, 1936 : 465, 1938 : 439) elaborate on this phenomenon in stating that from 37 per cent. up to 65 per cent. of abnormally (yellow) coloured males of a jassid bug were parasitized by Pipunculids. J. R. Williams (1957 : 100), in his study of the sugarcane-hoppers and their enemies in Mauritius, observed that larvae of *Cephalops* (as *Dorilas*) *mauritianus* Hardy were absent from first and second nymphal instars of the hosts, being found in third, fourth and fifth nymphal instars, the larval parasite not reaching maturity until after the host had become adult. Rarely, very small first instar pipunculid larvae were found in adult hosts. Stahl (1920 : 250–1), in his study of the beet-hopper (*Eutettix tenellus* Baker) in the Western United States, mentions that very small larvae of *Eudorylas subopacus industrius* Knab (as *Pipunculus industrius* Knab) were dissected in about equal numbers from nymphs and adults of the bug ; he does not mention whether these larvae occurred singly in individual bugs. Oviposition by Pipunculidae in or on adult Homoptera is apparently exceptional (see later remarks on parasitism by the pipunculid genus *Verrallia*).

It has been established that only a single pipunculid larva develops to maturity in the abdomen of the host hopper, although Keilin & Thompson (1915 : 4) state that sometimes more than one young larva occurs in the same host ; in these cases only one develops. Knowlton (1937 : 113) collected a male beet-hopper that contained two pipunculid larvae, the larger one in the abdomen, the smaller in the pro- and mesothorax of its host. Presumably, in this instance, the smaller larva would fail to reach maturity for lack of both nutrition and space. Williams (1957 : 101) dissected 80 nymphs and 90 adults of parasitized sugarcane-hoppers of the genera *Perkinsiella* and

Dicranotropis (both Delphacidae) and found that without exception each contained only one Pipunculid larva. No remains of dead larvae were found, and he concluded either that the adults do not oviposit into hosts already attacked, or, if they do, the eggs or larvae immediately after hatching fail to develop. Subramaniam (1922 : 465) makes the interesting observation that the young maggots of *Pipunculus* (s. str.) *annulifemur* Brunetti, which are rich orange in colour, have the peculiar habit of hopping, like fruit-fly maggots, when placed on a smooth surface.

It is evident that initially the young pipunculid larva is free in the abdomen of the host and has no particular orientation (Keilin & Thompson, 1915 : 2 ; Williams, 1957 : 100 ; and others) ; as the larva approaches maturity, however, it fills the greater part of the abdominal cavity, often extending into the thorax of its host, and necessarily its body must lie in the same direction as that of the latter. Imms (1960 : 635) states categorically that the head of the larval parasite is directed towards that of its host, and Perkins (1905 : 126) noted that this always appeared to be the case (fig. 2). Clausen (1940 : 392) repeated Perkins' remark. Keilin & Thompson (1915 : 2), in their study of the development of a Pipunculid larva, presumably of the genus *Chalarus* (as *Atelenevra*), observed that on reaching the late first stage it oriented itself so that its head was directed towards that of its host ; and that following the moult the then second stage larva reversed its position so that its head pointed towards the genitalia of its host. Hardy (1943 : 18) states that in the pipunculid *Alloneura* (as *Tomosvaryella*) *vagabunda* Knab the larvae usually face anteriorly in the body of the host, but some were directed posteriorly. He does not mention, however, whether all these larvae were mature examples. Although it is possible that the position taken up by the larva at various stages in its development may vary according to the genus or species, observations by Williams & Lindberg prove that mature larvae of a single species orient in either direction ; Williams (1957 : 100), in his study of the life-cycle of *Cephalops mauritianus* Hardy, states that when the larva is larger and fills much of the abdominal cavity, it lies with either the head or the tail forward, with about equal frequency, while Lindberg (1946 : 11) in his study of *Cephalops* (as *Pipunculus*) *chlorionae* Frey found that, of five second instar larvae, three had their head facing the posterior end of the host and two had their head facing its thorax. My own experience is that I have removed from examples of the common frog-hopper, *Philaenus spumarius* L., a very young first instar larva and a mature larva of *Verrallia*, and both were facing the head of the host.

The place of egress of the mature pipunculid larva from its host varies, and is probably to a certain extent controlled by its position at that time. Perkins (1905 : 126–7) found that the larva usually quits the host at the junction of the metathorax and the abdomen, either above or below, the segments being ruptured at that point (fig. 3). Bohemann (1854 : 303–4), describing the escape from its host of the larva of *Eudorylas* (as *Pipunculus*) *fuscipes* Zetterstedt, wrote that egress was achieved by means of slow contractions and expansions of the body and that it emerged from one side of the slender part where the abdomen is fused with the thorax. Haupt (1916 : 275–6) stated that parasitized adults of the Homopteron genus *Deltocephalus* (Cicadellidae) from which the pipunculid larva had escaped were always very elongated, completely empty internally, and broken at the right or left on the border between thorax and abdomen, so that the body

appeared to be bent at a right angle. Perkins (1905 : 127) once observed a larva escaping by a roundish hole in the mid-dorsal line about halfway along the length of the abdomen, the hole being irregular, as though gnawed. The host in this instance was a species of *Delphax* Fabricius (as *Liburnia* Stål), a delphacid Homopteron, and the pipunculid a species of *Cephalops* (as *Pipunculus*). Knowlton (1937 : 112–3), in his study of parasitism of the beet-hopper, states that the pipunculid larva sometimes breaks out through the middle of the hopper's abdomen, apparently by contracting and exerting pressure which splits open the body wall ; he adds that such a parasite was observed to have a part of its body projecting through a rent in the ventral body wall of a "pickled" hopper, while in another such specimen the larva had split the dorsal wall of its host, and had started to emerge. Lindberg (1946 : 12), who (as quoted earlier) found a majority of second instar larvae facing the thorax of their host in his study of *C. chlorionae*, provides the interesting fact that of eleven of these larvae one escaped between segments one and two, nine between three and four, and one between eight and nine.

The death of the already enfeebled and sluggish hopper inevitably takes place at the time that the pipunculid larva breaks out. According to Subramaniam (1922 : 465), in his study of the enemies of the mango-hoppers (*Idiocerus* spp.), hoppers thus affected are found adhering by their rostrum to the under-surface of the leaves of mango trees in shady places, with the abdomen partly split asunder. Apart from ultimately causing the death of the hopper, such parasitism frequently results in the abortion of the genitalia of the host, damage being more severe in the female. Giard (1889 : 709) appears to have been the first worker to have studied the abortion of the sex organs caused by the endoparasites of Homoptera. Williams (1957 : 101) found in some such cases that the reproductive organs were completely absent in both sexes, and Muir (1918 : 137) dissected males that had not only the penis and testes damaged but also the surrounding armature. Lindberg (1946 : 17–49) deals at length with this subject in his study of the parasitism of species of the Cicadellid genus *Chloriona* Fieber. Such genital damage may also be caused by various Strepsiptera and by aculeate Hymenoptera of the family Dryinidae, both of which as larvae are endoparasites of Homoptera.

After escaping from the host, the pipunculid larva in most cases falls to the ground and buries itself shallowly in the soil or burrows beneath surface rubbish. In certain apparently rare instances it pupates on the tree or bush on which the host hopper was feeding ; as in the case of *Dorylomorpha* (as *Pipunculus*) *xanthocera* Kowarz, the puparium of which Ott (1900 : 25) found fixed to the twig of a *Ribes* shrub, and in *Eudorylas* (as *Pipunculus*) *cinerascens* Perkins (1905 : 129), the larva of which forms its puparium on the surface of living leaves of the host plant, an Australian species of *Melaleuca* (Myrtaceae).

Occasionally puparia of *Chalarus* and *Verrallia* have been found in birds' nests, the parasitized bug nymph or adult having probably fallen or crawled therein and the emerging larva pupated in the same situation (see also keys).

Obviously, the time of emergence of the pipunculid adult and the duration of its various stages must synchronize with the life history of the particular hopper that it parasitizes. It is known that Homoptera are uni-, bi-, or even trivoltine, and therefore it can be assumed that some Pipunculidae are more than univoltine. Apropos Nearctic Pipunculids in general, Hardy

(1943 : 18) comments that most species are more abundant "in the spring and fall, due, of course, to two generations per season". It has been established that many species of Pipunculidae pupate in the autumn and overwinter in that stage, emerging as adults in the late spring or early summer. Knowlton (1932 : 42), in his study of the beet-hopper (*Eutettix tenellus* Baker) in Utah, suggests that some pipunculid larvae pass the winter in adult survivors of the hopper and become adults in the spring. Substantiating this, he states that one dark female *tenellus* was collected in March and found to contain a large pipunculid maggot. Dealing with the biology of *Cephalops chlorionae* Frey, Lindberg (1946 : 14) shows how the partly developed nymphs of the host hoppers (*Chloriona* spp.) overwintering in the stems of *Phragmites* sometimes contain the larva of the Pipunculid ; the hoppers reaching maturity in the following June and the parasitic larvae becoming puparia soon after, and remaining in that stage for about 24 days. From Lindberg's account it is evident that in this instance the leafhopper and its parasite are univoltine.

Host selection in some Pipunculidae appears to be specific, but others have been bred from several different species of hopper and even from widely separated genera. An interesting fact arises from my collation of breeding records and separation of pipunculid material into the eight principal genera recognized by Collin (1956 : 154–5) and myself ; namely, that each of the six of these genera of which there are host records appears to confine its parasitism to single families of Homoptera (with one recorded exception in a species of *Eudorylas*). *Chalarus* selects Cicadellidae (Jassidae) of the subfamily Typhlocybinae (Giard, 1889 : 708–10 ; Keilin & Thompson, 1915 : 9–12 ; Blair, 1943 : 129 ; Hardy, 1943 : 37). *Verrallia* selects Cercopidae (Jenkinson, 1903*a* : 222 ; J. Waterston, unpublished record—see under *Verrallia* key). *Alloneura* selects Cicadellidae (at least eight records of several species of the genus). *Pipunculus* s. str. selects Cicadellidae (three records of *campestris* Latreille). *Cephalops* selects Delphacidae (numerous host records of various species of the genus in Europe, and in Hawaii all bred Pipunculidae fit into this pattern—see Hardy, 1964 : 302–79). *Eudorylas* selects Cicadellidae, with the exception of the Australian *E. helluo* Perkins, which Perkins recorded as bred from two genera of Flatidae (1905 : 144) ; he bred *helluo* from nymphs of *Siphanta* sp. on several occasions, and records it as bred from a *Poeciloptera* sp. by a Mr. Koebele. Otherwise, there are numerous records from Europe and elsewhere of *Eudorylas* selecting Cicadellidae. *Dorylomorpha* and *Nephrocerus* appear to be without host records. (More detailed host records of the other six genera appear under subsequent generic headings in the keys.)

Besides the families of Homoptera mentioned above as hosts of Pipunculidae, Hardy (1964 : 303) states that he has seen specimens of an apparently new pipunculid species which had been reared from nymphs of the membracid *Otinotus bantuantus* Distant in South Africa.

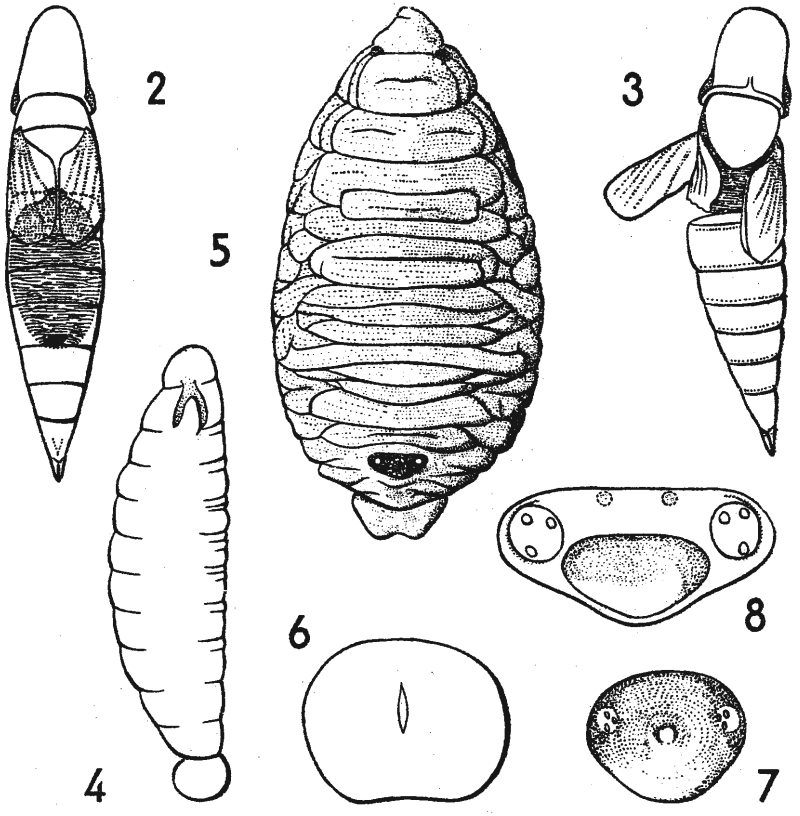
It is interesting to note that *Verrallia* is the only genus of Pipunculidae recorded as attacking the adult Homopteron exclusively, the mid stage nymphs being the normal selection, although it has been observed (*e.g.*, Stahl, 1920 : 250) that both nymphs and adults may be parasitized by individual species of Pipunculidae. In the case of *Verrallia*, the Cercopidae (or frog-hoppers) is the selected family of Homoptera, and there are two probable reasons why the adults only are parasitized ; firstly, the soft-

bodied nymph of the hopper in its spittle-like secretion would most likely not have the endurance to attain maturity with the developing pipunculid larva in its abdomen, and secondly, the spume itself apparently deters the fly from ovipositing on or in the nymph. I have watched females of *Verrallia* seeking their Cercopid hosts, and without exception when spume was encountered the fly would veer away from it. According to Imms (1960 : 438), however, the spume does not deter fossorial Hymenoptera and other enemies from snatching out the Homopteron nymph. The *Verrallia* larva has several months in which to develop in at least the common British Cercopid, *Philaenus spumarius* L., for the latter begins to emerge in the spring and at least the females are active until autumn.

Descriptions of Early Stages

1. *Egg*

Until now nothing appears to have been known of the pipunculid egg,



Figs. 2–8.—2 *Hecalus* sp. (Hemipt.) with larva of *Pipunculus* (s. lat.) *cruciator* in abdomen (after Perkins 1905). 3, ditto, after escape of the full-grown larva (after Perkins 1905). 4–5, *Cephalops mauritianus*, larva (after Williams, 1957). 4, first-stage ; 5, mature. 6, *Verrallia* sp., terminal vesicle of first-stage larva, showing anal opening, from behind. 7–8, Chalarinae, posterior spiracular plate of mature larva. 7, *Chalarus spurius* (drawn from puparium) ; 8, *Verrallia* sp.

although H. Loew (1841) described as flask-shaped (p. 78) what he erroneously believed to be one ; a tiny outline drawing of this object appears in Loew's work (Tab. 4. fig. 15), and in his list of legends to drawings (p. 124) he refers to it as "Ei von *Pipunculus campestris* Latr." From my own investigations I am satisfied that the egg figured by Loew is not that of a Pipunculid. It seems likely that Loew saw a Pipunculid pounce upon an ovipositing Homopteron, and wrongly associated the egg or eggs of the latter with the Dipteron.

My remarks on the development of the pipunculid egg within the female ovaries are included in the section dealing with Adult Structure under the sub-heading, "Female Ovaries and Egg development".

2. *Larva*

The larva (figs. 4, 5) is oblong, subcylindrical, and rounded at both extremities. When young it is sometimes more slender and elongate with smoother softer integument. Perkins (1905 : 128–9), however, states of pipunculid larvae in general that individuals about one-third developed are frequently much more contracted than fully grown ones, or even almost globular. A mature *Verrallia* larva that I have examined is somewhat narrower and more elongate than the mature larva of C. *mauritianus* Hardy as drawn by Williams (fig. 5), but as Williams killed his example in alcohol with consequent shrinkage and mine was killed by plunging it into very hot water with consequent full extension of the larva, the difference may be less than portrayed. The colour may be whitish, greyish, dark or of a brighter hue and sometimes varies in the different instars. Subramaniam (1922 : 465) describes the young larva of *Pipunculus* (s. str) *annulifemur* Brunetti as being rich orange, while Vimmer (1926 : 122) describes as orange-yellow the mature larva of *Pipunculus* (s. lat.) ? *pratorum* Fallén. Young pipunculid larvae are sometimes only 1·00 mm. in length. The number of body segments (including the head and excluding the terminal vesicle) in the young larva (fig. 4) is eleven ; in the more mature larva (fig. 5) the intricate transverse folding of the integument makes the segmentation obscure, although it is generally agreed that ten or eleven segments appear to be present. Lundbeck (1922 : 6) is apparently alone in considering that the larvae are 12-segmented in the later stages. It is not always clear whether authors are including the head and/or terminal vesicle as separate segments. Hairs and/or spines are sometimes present on the integument.

The mouth is a simple opening without external chitinized parts. Williams (1957 : 98–99) found the buccopharyngeal armature of the first stage larva (fig. 4) of *C. mauritianus* Hardy to be well developed with distinct sclerites, whereas in the mature larva of that species these were more obscurely formed. Keilin & Thompson (1915 : 2) state that in *Chalarus spurius* Meigen the buccopharyngeal armature of the first stage larva is reduced to a hardly chitinized, almost transparent basal piece, while in *Verrallia* I have found the armature to be well-developed in both young and mature larvae. Adjacent to the mouth-opening a pair of antenno-maxillar organs are present, and are usually well developed and readily traced in later stage pipunculid larvae.

At the posterior end of the body there is, in material so far examined, a vesicle-like organ, which Keilin & Thompson (1915 : 2) found in *C. spurius* Fallén to be well developed in first stage larvae and still present although

relatively reduced in size in more mature larvae. Williams (1957 : 98–99) described and figured a similar vesicle (figs. 4, 5) present in both young and mature larvae of *C. mauritianus* Hardy.

In a young first stage larva of *Verrallia* that I have examined, the vesicle (fig. 6) is transparent, golden-yellow, semiglobose, convex above and broadly excised and concave below. A somewhat older, probably second stage, *Verrallia* larva has the vesicle similarly shaped, but opaque and cream-coloured. The vesicle in a mature *Verrallia* larva is likewise opaque and cream-coloured, but it is broader, not strongly rounded, and very weakly bilobed. In all *Verrallia* larvae examined, the anal opening (fig. 6) is clearly seen at the posterior extremity of the vesicle, as was earlier noted in other pipunculid larvae by Keilin & Thompson (1915 : 2). A similar bladder-like terminal structure occurs in the endoparasitic larvae of several genera of Braconidae (Hymenoptera), e.g. *Microgaster*.

Young first stage larvae appear to be apneustic without distinguishable trachea, but later these become air-filled and obvious. The more mature larvae are clearly amphipneustic, the front pair of spiracles being situated just behind the mouth, and the hind pair on a dark chitinized plate just short of the posterior extremity. The anterior spiracles are small but distinct, projecting slightly from the integument, and having at the top several openings ; the usually pale yellowish posterior spiracles project from the lateral margins of the frequently polished and more or less depressed chitinized plate ; the latter is variable in shape and size, sometimes being very small and only slightly depressed, as in *Chalarus spurius* (fig. 7), and in other instances consisting of a large funnel-like more or less deep depression (figs. 8, 9) which may bear several pairs of yellowish tubercles (fig. 9) besides the anterior spiracular pair.

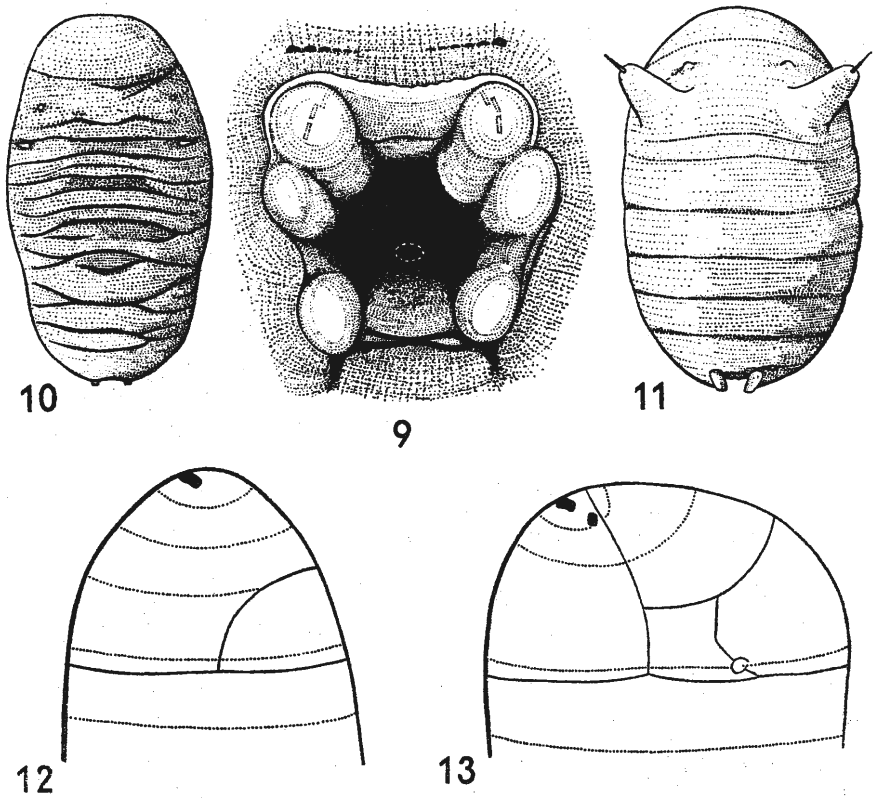
Each posterior spiracle has three simple openings in a mature *Verrallia* larva (fig. 8) and in the puparia of other pipunculid material that I have examined. (The spiracular openings are, as usual, more distinct in the puparium.) Clausen (1940 : 393), however, states of pipunculid puparia that, although generally each posterior spiracle has three openings, "in some species there are two and in others only one". To illustrate this point Clausen reproduces (his figures 178d to 178f) Perkins' (1905, plate 7) drawings of the posterior spiracular area of the puparia of *Pipunculus* (s. lat.) *cruciator* Perkins and *hylaeus* Perkins, and of *Eudorylas cinerascens* Perkins. In Perkins' original drawings three posterior spiracular openings are shown clearly in all three species, but the reproductions in Clausen show such blurred impressions of the openings that one might consider their number to vary from one to three ; I have examined puparia of *cruciator* and *cinerascens* and confirm that in both these species there are three openings to each posterior spiracle. Williams (1957 : 100) states that in *C. mauritianus* Hardy the posterior spiracles of the mature larva each bear two or three openings ; his figure (9*c*, p. 99) clearly shows only two openings, but my examination of the puparium of the type of *mauritianus* reveals three.

The number of larval instars in Pipunculidae is not fully agreed among authors, and may possibly vary in the different groups. Keilin & Thompson (1915 : 1) and Williams (1957 : 98–99) stated respectively that the larvae of *Chalarus spurius* Fallén and *Cephalops mauritianus* Hardy have only two instars. Hardy (1943 : 17) writes of Pipunculidae in general that the exact number of larval instars is doubtful ; and that from his own studies of

available larvae there appear to be four distinct instars, and even in some instances five growth stages from young to mature larva.

3. *Puparium*

The puparium (figs. 10, 11) is broadly oblong, rounded at the ends, and in transverse section more or less cylindrical. Being formed from the shrunken, hardened and darkened larval cuticle, it exhibits to a greater or less extent the general features of the mature larva, including such spines



FIGS. 9–13.—9, *Eudorylas cinerascens*, posterior spiracular plate of mature larva (after Perkins 1905). 10–11, Puparia (after Perkins, 1905). 10, usual type. 11, *Eudorylas cinerascens*. 12–13, Lateral view of anterior portion of puparia, showing operculum (after Hendel). 12, *Pipunculus* (s. lat.) sp. 13, *Chalarus* sp.

and/or hairs as may be present in the latter ; the surface may be almost smooth, or finely shagreened, sometimes corrugated or regularly sculptured, and there may be rows of depressions laterally. An exceptionally spiny and hirsute puparium, according to Ott (1900 : 25), is that of *Dorylomorpha xanthocera* Kowarz, which has the entire upper surface covered with sparse hairs and bearing a number of long strong spines which each carry whorls of erect bristly hairs.

After the hardening of the puparium the anterior spiracles of the larva cease to function, and the pair of normally small slender anterior respiratory cornua of the pupa thrust through weakened areas of the integument between the fourth and fifth segments, occupying a more or less dorsolateral position. Exceptionally (possibly uniquely) in the Australian species *Eudorylas* (as *Pipunculus*) *cinerascens* Perkins the anterior cornua (fig. 11) are relatively enormous, conical in shape, dark reddish and tipped with a fine, spine-like process (see also under *Life-History*). The dark chitinized plate bearing the posterior spiracles of the mature larva has already been discussed under the previous heading.

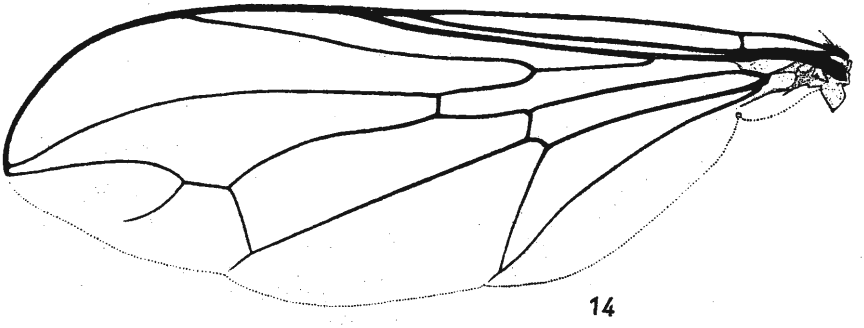


FIG. 14.—*Nephrocerus flavicornis*, wing.

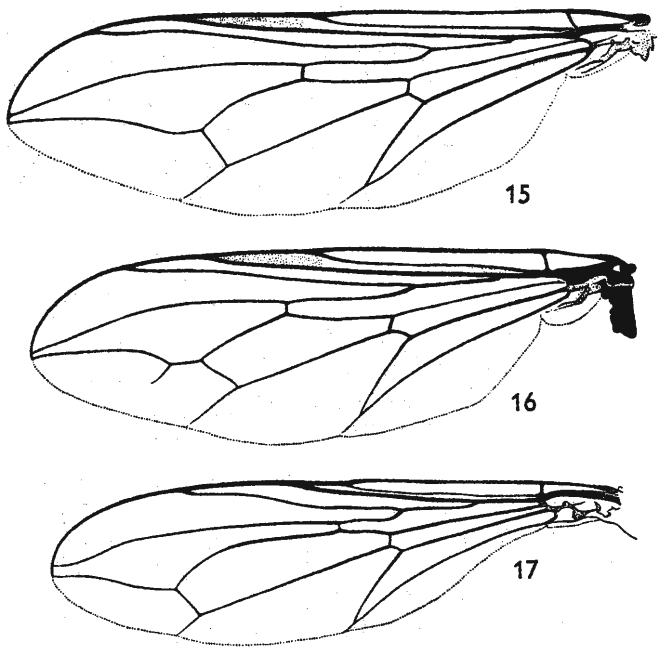
The operculum (figs. 12, 13) appears to consist of two detached pieces in the majority of Pipunculidae (fig. 12), and of five pieces in *Chalarus* (fig. 13) and *Verrallia*, exactly the same area being involved in both types, *i.e.* all the anterior segments to just behind the front margin of the fifth. De Meijere (1916 : 236–8) and Lundbeck (1922 : 7–8) discuss at length the composition of the parts detached in the above groups. Several authors, however (*e.g.* Scott, 1908 : 10 and Williams, 1957 : 100) have noted divergences from the usual patterns and further study is desirable.

ADULT STRUCTURE

The head is large, varying in shape from semiglobular to nearly globular. It consists mainly of the bare compound eyes, which are usually contiguous in the males, and always dichoptic in the females. The three-segmented antennae have the first segment very small and inconspicuous, the second deeper and usually quite small, but sometimes almost equal in size to the large third segment. The arista is three-segmented, simple, thickened at the base, and exhibits little variation. The mouthparts are of the typical Muscoid type. In some groups the disc of the thorax is almost devoid of hairs and bristles, in others there is an even covering of hairs with or without strong bristles. The humeri vary in coloration from pale yellow to black, and the propleurae are with or without a vertical fan of distinct even if small hairs.

The body varies from pale grey to black and a varying degree of pruinosity may be present ; in the female the body and leg coloration is frequently

paler. The abdomen is usually sparsely clothed with short hairs, but in some genera both hairs and bristly hairs are well developed and more or less abundant. In the male the segments following the fifth tergite are more or less twisted towards the left and bear the genital parts ; the apical, often large, eighth segment usually has a membraneous area of varying size, frequently termed the apical cleft, although it may be by no means narrow.



FIGS. 15–17.—Wing. 15, *Verrallia villosa ;* 16, *V. aucta ;* 17, *Dorylomorpha confusa.*

The ninth segment and copulatory parts fold into the large genital chamber. The female ovipositor is curved in under the abdomen, usually conspicuously so, and is made up of abdominal segments seven to nine ; it consists of a basal part and a piercer, which are usually fused. The anal opening is on the dorsum of the piercer, near its junction with the base, and has a pair of pilose cerci. The three spermathecae are situated in the basal part, and tend to assume a striking diversity of form in the different groups (see Harris, 1966).

The legs are normally simple and mainly short haired, although in some groups the femora have quite a long posterior ciliation and long tarsal hairs may be present ; a small cluster of tiny spines sometimes occurs on the trochanters and femora ; the claws and pulvilli are generally large, often more so in the females.

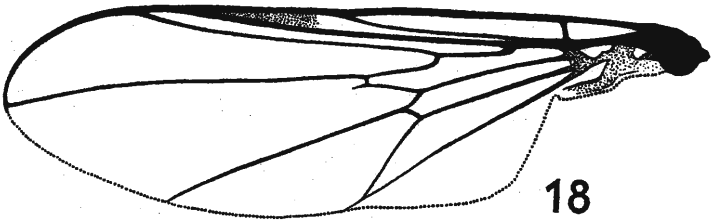
The wings are usually quite narrow, as long as or longer than the body. The venation (figs. 1, 14–19, 23) varies somewhat in the different genera, and a stigma is present or not ; the alula is practically absent, and the axillary lobe, although quite well developed in the male of *Chalarus* and to

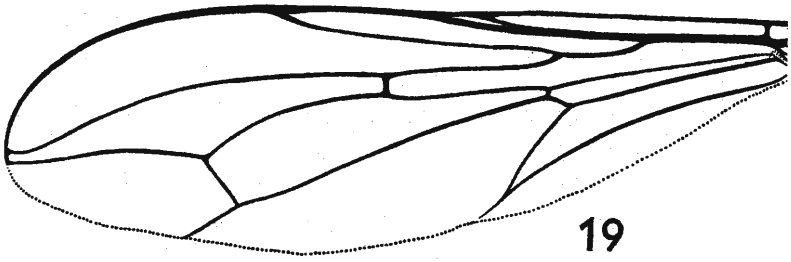
a lesser extent in both sexes of *Verrallia*, is at most only weakly developed in the other genera.

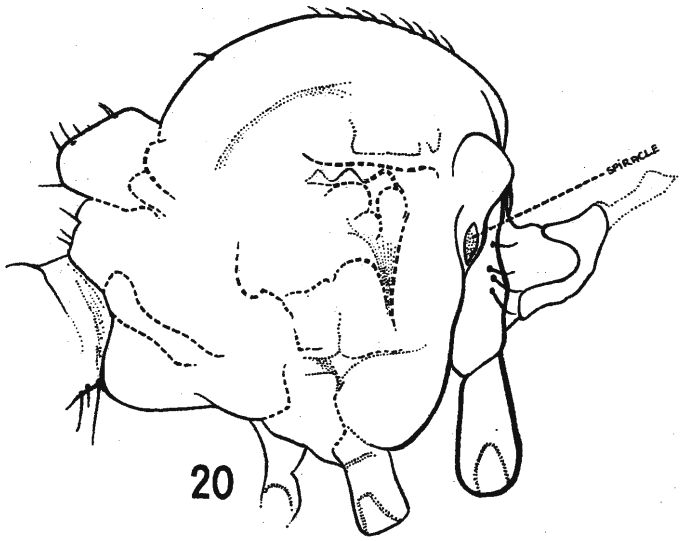
(For an extensive account of the adult structure see Lundbeck (1922 : 1–6) and Hardy (1943 : 9–15.)

Female Ovaries and Egg Development

D. Elmo Hardy (1943 : 15) stated that the ovaries of the female Pipunculidae are difficult to study because of their position and small size. My







FIGS 18–20.—18–19. Wing. 18, *Chalarus spurius*; 19, *Alloneura sylvatica*. 20. *Cephalops vittipes*, thorax, from side, showing propleural hair fan.

own limited experience has been, however, that in host-seeking females the ovaries are well developed and conspicuous, but that casually captured females usually include recently emerged individuals in which the ovaries are undeveloped and difficult to discern. These extremely delicate organs may be seriously damaged or destroyed by the action of some chemicals commonly used in preparation, and freshly killed material should be immersed in saline for examination.

Two host-seeking females of *Verrallia villosa* von Roser and *V. setosa* Verrall were taken by myself at Addington, Surrey, in August, 1965, and on dissection were found to have the remarkably large and well-developed ovaries attached to the body-wall of abdominal segments 3–6, occupying much of the space within these segments ; in both specimens there appeared to be about six pairs of ovarioles and roughly 100–150 eggs in various stages of development.

Plate I is a photograph of the ovaries of the example of a female *villosa* mentioned above, and the following notes on these organs result from an examination of that specimen. The penultimate egg-body in each ovariole appears to be almost entirely yolk-filled, and in shape is elongate-oval, broadly rounded at one end and more narrowly so at the other ; it is dull whitish and semi-opaque. Situated at the common junction of the ovarioles, apparently positioned for expulsion through the ovipositor, are a number of bodies of a different shape ; these are elongate, broadly rounded at one end, remaining equally broad for about half their length, and then gradually narrowing to the rather blunt opposite extremity ; they are transparent, encased in a thin smooth shining membrane without obvious chorion, and, within, the bulk of the diffused yolk is seen to be concentrated along the narrowing portion, there being little or none at the actual broad extremity. Some of the examples exhibit at the narrower end a small bulbous development, which may be the rudiment of the posterior vesicle of the larva. (It should be noted that the transparent bodies in the illustration are floating loosely in the dish containing the preparation.) Although it would appear that the transparent bodies are those actually inserted singly into the host-bug it is possible that the first-instar larva may develop immediately prior to expulsion.

A female of *Pipunculus campestris* Latreille taken with the *Verrallia* discussed above was found on dissection to have large ovaries occupying a similar area of the abdomen, but none of the ultimate transparent bodies found in *Verrallia* could be traced. However, this particular female was not definitely host-seeking, and the ovaries were possibly slightly immature. Ten pairs of ovarioles were traced, and roughly 250–300 developing eggs.

The further investigation of the early development of Pipunculidae undoubtedly offers students a rich field for study.

Adult Habits

Adult Pipunculidae are unobstrusive in their habits, usually flying alone in low herbage or among the foliage of shrubs and trees. Where large numbers of the host bug are concentrated in a small area on low foliage, however, they are occasionally found in numbers. There is little doubt that some apparently rare species parasitize arboreal leafhoppers and are thus likely to escape notice to a considerable extent. Contrary to the statement in Imms (1960 : 634) that they are usually to be taken on flowers, I cannot

recall ever seeing a Pipunculid on any kind of bloom, and supporting my own experience Lundbeck (1922 : 9) remarks, "they do not seem to be attracted to flowers at all". The only recorded observations on their feeding habits that I have traced are by F. X. Williams (1918 : 190), who, in Hawaii, frequently saw both sexes of several pipunculid species feeding on dew or honeydew on sugarcane leaves and by J. R. Williams (1957 : 100), who saw *Cephalops mauritianus* Hardy feeding upon honeydew dropped by the sugarcane Aphid (*Longiunguis sacchari* Zehnter). Many years ago, when collecting Pipunculidae at Bembridge in the Isle of Wight, I took fair numbers of several species of the flies feeding early in the morning on honeydew on the leaves of a lime tree in a sheltered position. A male of *Chalarus spurius* Fallén in the B.M. British Collection bears a note by its captor, Mr. A. H. Hamm, "feeding on honeydew", and a female of *Verrallia setosa* Verrall that I kept alive for several days sucked up moistened sugar with avidity. Besides, Hardy (1943 : 19) mentions that he has seen these flies alighting upon a moist stone, leaf or twig by a mountain stream and appearing to lap up the moisture.

Pipunculidae are only occasionally seen on the wing when the foliage is extensively wet, or when a fairly strong breeze is blowing. They are most active when the day is calm and sunny. In my experience of collecting at the fringes of woodlands and in glades during a prolonged spell of dry weather. Pipunculidae are best sought in the lowest (*i.e.* dampest) parts. In Britain, under suitable conditions, I have found most species to be more active in the mid-afternoon, although some appear to prefer early in the day and others are more often seen towards sundown. Mating in the majority of species occurs in obscure situations and is only infrequently observed. It usually takes place on the wing, although Dr. Burtt took mated couples of *Cephalops semifumosus* Kowarz at Goring Heath in Oxfordshire, sometimes hovering and at other times resting on the leaves of shrubs ; *semifumosus* is one of our commoner British species, and is exceptional in its habit of mating in quite conspicuous, open situations. On another occasion in the same locality Dr. Burtt captured a mated couple of *Dorylomorpha rufipes* Meigen resting on the leaf of a shrub. In keeping with the more usual habits of Pipunculidae, a mated pair that I took of the uncommon *Cephalops subultimus* Collin at Ashtead Woods, Surrey, in 1932 were hovering almost motionless in a scooped-out hollow under a dense bramble bush and would undoubtedly have been overlooked but for a shaft of sunshine showing up the iridescence of their wings.

Bristowe (1950 : 264) described in detail the mating of *Eudorylas zonatus* Zetterstedt (as *Pipunculus distinctus* Becker), and I repeat his excellent account, "On June 24th, 1950 I saw, as I thought, a strange-shaped fly held motionless in some invisible spider's web a foot above the ground between some shrubs in my garden, so I stooped to examine it. Apart from pivoting its head towards me there was still no change of position although I could then see that there was no restraining or supporting spider's web and that it was two flies in copulation. The female was lying still, almost horizontal but slanting slightly downwards anteriorly ; the male's body above her was tilted upwards anteriorly and his vibrating wings kept them both suspended in mid-air without the slightest upwards or sideways movement. I watched for four minutes, hurried indoors to fetch a glass tumbler and caught them in it whilst they were still in the same position six and a half minutes after I had first seen them. I cannot trace any published observations on the mating

habits of *Pipunculus* or anything quite like this among other flies, so I have thought it worth recording what I saw."

As Hardy (1943 : 15) remarks, in copulatory position the piercer of the female ovipositor fits up into the genital cavity of the male in order that the vagina may be reached by the aedeagus. From the few eye-witness accounts of oviposition, it appears that this usually takes place in the air, the female fly pouncing upon its victim and carrying it off in the firm grip of its large claws. Williams (1918 : 190), in his study of the Pipunculids parasitizing the sugarcane-hoppers in Hawaii, gives the following interesting account of this process, "The female fly is sometimes deceived into snatching momentarily at leafhopper moult skins. The victims selected are very small to perhaps a little less than half-grown hoppers. A suitable one being discovered by the hovering fly is suddenly pounced upon and snatched up into the air. The captive is sometimes dropped almost immediately as if unsuitable ; others, however, are held in mid-air for from one to several seconds, the fly usually rising a little with her burden which would be dropped on to a leaf or on to the ground. Often, immediately after, the Pipunculid would hunt out another hopper, showing that she must have several eggs ready for laying. While in the air with her victim, her abdomen could be seen curved towards it ; she is provided with a sharp corneous ovipositor with which she either pierces the hopper's body or inserts her very small egg (*not seen*) under a body fold. At any rate the hopper seems unhurt and usually hops away. If the young hopper is too large, the fly is sometimes apprised of the fact by being hurled back by the insect's vigorous leap." He also noted that the newly parasitized hoppers soon returned to their host plant.

Hardy (1943 : 6) stated that the actual oviposition process is very difficult to observe because of the rapidity of the action involved, but that the female inserts its ovipositor in the conjuctiva between the sclerites of the abdomen. It is most likely that a female deposits only a single "egg" (*see also under* Female Ovaries and Egg Development) in an individual hopper, for the mature pipunculid larva takes up the available space in the abdomen of the particular species of hopper that it parasitizes. It appears probable also that once an "egg" has been deposited in a hopper that individual is not usually selected for parasitism by another Pipunculid (see also under *Life-History*). Jenkinson (1903*a* : 222) watched the behaviour of *Verrallia aucta* Fallén in parasitizing adults of the common species of froghopper, *Philaenus spumarius* L. (Cercopidae), in his garden at Cambridge. He writes, "Noting *V. aucta* to be common on the morning of July 5th, I determined to watch them as they busily beat over every inch of the herbage .... As soon as a *Verrallia* saw a froghopper it poised itself in the air (like a kestrel hovering, but with a certain intensity perceptible in its motionlessness) and if the position of its victim was favourable, it pounced upon it immediately. Then the frog-hopper hopped ; in some cases the fly lost it ; in some cases the fly reappeared instantly from the place to which the frog-hopper hopped. In one case I saw the frog-hopper land with the fly still on its back .... If the position was unfavourable, or stems got in the way (*e.g.* of *Geranium robertianum*) the fly would circle round with its head towards its victim, like a male *Dolichopus*, seeking a point from which to pounce. On several occasions it failed to get a hold. Once a fly pounced upon a frog-hopper *which did not hop* ; the fly immediately left it. Another came up and looked at it, but went away without touching it. Was the frog-hopper already entertaining an egg, or was it

a male, or for some other reason unsuitable?" Jenkinson implies that a froghopper's failure to hop might be due to its having already been parasitized by a Pipunculid, but I have extracted larvae from actively hopping examples of *spumarius*. As to his other suggestion that a male bug might not be selected because of its sex, from existing records it appears that the sexes are parasitized impartially.

Ectoparasites and Predators

Records of internal parasitism of Pipunculidae are rare, and appear to be confined to the larval and pupal stages, although Verrall (1901 : 62) states that he examined specimens of the adults that seemed to be occupied by some internal abdominal parasite, and were consequently distorted in shape. Perkins (1905 : 127), however, discredited Verrall's surmise ; he too had noticed irregularities of the surface of the abdomen, particularly in male examples, that might be said to produce a distortion of the body, but considered that the cause could certainly not be internal parasitism, since he had found such a condition in every example of some common species.

Internal parasitism of the larva is recorded by Muir (1921 : 122) in a lecture on the parasites of the sugarcane hopper in Hawaii, when he mentioned that even in the body of the hopper the fly grub (*Cephalops* (as *Pipunculus*) *hawaiiensis* Perkins) is not concealed from its enemies, for a small wasp of the genus *Eucoila* (Eucoilidae) parasitizes it at that time.

Perkins (1905 : 127) records that he bred a species of Chalcid (Encyrtidae) from the puparium of *Eudorylas* (as *Pipunculus*) *cinerascens* Perkins, a Pipunculid that pupates on the surface of the living leaves of *Melaleuca* (Myrtaceae) in Queensland. He queries whether the puparia of (normal) subterranean habit are likewise attacked unless the parasite stings the pipunculid larva while the latter is still in the leafhopper, which he considers doubtful because he had never bred Chalcids from the numerous Pipunculids reared. Lundbeck (1922 : 10) remarks that he bred a Proctotrupid (*Basalys erythropus* Kieffer) from a puparium of *Dorylomorpha* (as *Pipunculus*) *xanthopus* Thomson found in flood refuse in Denmark, and suggests that in this instance the larva was parasitized during the short time between leaving the host and pupating.

Several species of Pipunculidae were amongst the prey stored in a nest of the Crabronid wasp, *Crossocerus* (*Coelocrabro*) *pubescens* Shuckard (as *Blepharipus nigritus* Lepeletier and Brullé), found by Scott (1925 : 157) in South Devon. Blair (1943 : 129) found among the prey in wasps' burrows in an old beech tree in Wiltshire some paralysed Typhlocybinae (Homoptera) amongst which was a crippled specimen of *Chalarus spurius* Fallén and its empty puparium. Williams (1918 : 191–2) stated that in Hawaii a nest of a *Nesomimesa* wasp (Psenidae) contained 62 specimens of the sugarcane leafhopper of which 15 were parasitized by *Pipunculus*, all but one being males.

Collecting and Preparation

Pipunculidae should normally be collected individually. This method of capture is recommended, firstly, because they are in the main solitary fliers, and, secondly, careful netting ensures a perfect specimen whereas swept material of this family frequently suffers by having the wings torn and perhaps the head missing. My method is to hold the net upside down over the

hovering insect, which then flies straight up into the bottom of the net. By gently compressing the net around the fly it is at last restricted to a tiny fold of the material. The open killing tube is then inserted into the net and manoeuvred over the insect and the cork pressed on from outside. Directly the fly topples over unconscious, the tube is removed from the net with the thumb covering the neck and the cork then pressed on firmly. Resembling Pipunculidae to a considerable degree as they hover in the undergrowth, are flies of the Syrphid genus *Neoascia* and certain small blackish Staphylinid beetles, and I have sometimes netted these in error.

Dr. E. Burtt has successfully collected series of *Chalarus* spp. by carefully placing a glass tube over individuals as they rested on leaves of shrubs, and rapidly corking it as they flew upwards, afterwards stupefying his captures by introducing a drop of ethyl acetate into the tube on filter paper or some other suitable material. The specimens are then transferred to a killing bottle. Resting individuals may often be caught by sucking up with a "pooter" and dealing with similarly. Again I would emphasize that a calm, sunny day when the foliage is dry affords the best collecting conditions. In the United States of America Hardy (1943 : 19) has experienced excellent collecting when sitting beside a small mountain stream and taking the species (of Pipunculidae) as they came in to the water. He states that such a situation sometimes yields species that are seldom taken elsewhere, possibly because they may parasitize arboreal hoppers and are not easily obtainable in their natural habitat. I have had no experience of this way of collecting, but it might well be successful in similar places in Britain.

In the case of such fragile flies as Pipunculidae it is highly desirable that one's captures should be pinned in the field whenever possible and I suggest that before starting off on a day's collecting a pocket box should be equipped with a supply of suitable micro-pins stuck vertically in a corner of the soft lining material.

An alternative method of obtaining adults of Pipunculidae is to breed out the (preferably well-developed) larvae from parasitized leafhoppers. Means of obtaining hoppers in this condition have been described by Tetens (1889 : 3) and by Williams (1918 : 190–1). Tetens states that he secured excellent results by searching on tree-trunks for parasitized hoppers, which (he writes) can usually be picked out with ease by their weak movements and awkward attempts to fly, as well as by the irregular position of their wings. Williams, studying the sugarcane-hopper in Hawaii, found it best to sit down before a clearing among cane leaves, shake down a number of hoppers and place leaves bearing many young (hoppers) in suitable positions, and carefully but quickly follow a burdened (*i.e.* hopper-carrying) Pipunculid with a white cloth or handkerchief held beneath her. As soon as the hopper is liberated, it falls on the cloth and a wide-mouthed vial is clapped over it. He managed thus to secure six or seven parasitized hoppers in about an hour. By Williams' method only freshly parasitized hoppers were captured, naturally, thus making more difficult the task of successfully breeding out the adult Pipunculidae. The use of a lepidopterist's beating-tray might prove successful for securing "pipunculized" arboreal hoppers, and use of a sweeping-net amongst mixed vegetation should produce good results.

References in the literature to methods of rearing Pipunculid adults from parasitized hoppers are very few. Tetens (1889 : 1) placed affected bugs in glass tubes, and later the fully grown pipunculid larvae emerged and in at

least one instance pupated free at the bottom of the tube, a *Chalarus* adult eventually emerging. Lindberg (1946 : 12) placed affected nymphs and adults of *Chloriona* spp. in glass tubes either with pieces of paper and/or pieces of *Phragmites* leaves (on which these hoppers had been feeding) or in the empty tube, and the parasitic larvae (of *Cephalops chlorionae* Frey) under these conditions pupated, sometimes on one or other of the materials or at the bottom of the tube, adults later emerging. Because only a single Pipunculid larva develops inside an individual leafhopper, the problem of following through and associating the larval instars, puparium and adult of a particular species is indeed difficult. Actually, one should breed a series of a species of leafhopper from egg to mid-nymphal stage, then place with these nymphs a fertilized female of a species of Pipunculid known or suspected to parasitize that species of hopper in the hope that it would oviposit in or on one or more of the nymphs. It would then be necessary to kill one affected hopper and remove an early first instar larva and preserve it, and as development takes place, a late first instar, an early second instar, late second instar and an early third instar ; this assumes that there are three larval instars, although, according to present knowledge, the number of instars appears to vary. The remainder of the larvae would be allowed to pupate and in due course emerging adults would be checked with the original egg-laying female. The necessity for breeding the hoppers from the egg stage arises because another Pipunculid species might already have oviposited in a wild nymph, and if so the larva resulting from this earlier parasitization would be more mature than the larva resulting from the later oviposition and the latter would die, with consequent ensuing confusion.

Preservation of the early stages is simple. Larvae (regardless of instar) are best killed by momentary immersion in hot (not boiling) water, which fully extends the specimen. The larva is then placed on white blotting-paper to absorb the surplus moisture, and preserved in a tube of 80 per cent. alcohol. Puparia can be treated in the same way.

It is sometimes necessary to dissect and mount genitalia in order to determine a specimen accurately. I find that a safe way to remove the genital segments is to hold the tip of the abdomen resting flatly on a narrowly ridged lump of plasticine and press down firmly with a sharp safety razor blade on the preceding segment, making a clean cut ; the female ovipositor, however, can sometimes be detached by gently and steadily pressing a needle between it and the body. Edwards' (1929 : 282) method of preparing genitalia for study is excellent and I repeat it here: "(1) place the specimen in strong potash in a narrow tube, the tube then being placed upright in an outer vessel containing water, which is just brought to the boil ; (2) remove from potash to a dish of glacial acetic acid, to which a few drops of Ziehl's carbolic fuchsin have been added (if the specimen needs staining) ; (3) after five minutes or so remove to pure glacial acetic acid ; (4) after a minute or two (a few seconds if stain has been used) remove to clove oil ; (5) mount in a very small drop of canada balsam in xylol (or another suitable mountant) on a small celluloid strip, arranging specimen in desired position with needles under binocular ; (6) when dry and set, add a little more mountant until specimen is completely covered. No matter for how long a specimen has been dried, good preparations can always be made in this way." I have found that to ensure sufficient depth of the mountant it is advisable to nick the celluloid mount at the edges and turn up a narrow strip at the sides and

at the front ; this method prevents excessive convexity of the mountant with probable distorted view of the specimen. A cover-slip is not used, and the mount is pinned with the specimen.

The large and more or less globular head of the Pipunculidae is so tenuously attached to the thorax that a slight shock frequently detaches it. When this happens the head can either be replaced with a suitable adhesive or mounted on the top of the micro-pin holding the specimen ; if the latter method is adopted, affix sufficient adhesive to the pin, and immediately with a fine camel-hair or sable brush press the hollow part of the head firmly down over the top of the pin so that it rests there securely. Actually, it is sometimes necessary deliberately to detach the head of a specimen in order to ascertain whether or not a propleural hair-fringe is present.

Fossil Pipunculidae

Until quite recently our knowledge of fossil Pipunculidae rested meagrely on the works of Loew (1850) and Meunier (1899 and 1903). Then in 1939 Carpenter & Hull published their paper dealing with six fossil species, four of which were described as new. With the exception of a single species from Florissant, Colorado, U.S.A. (Miocene), all are from Baltic amber (Oligocene). Hull, who was responsible for the systematic part of the paper, placed considerable importance on the fact that all six species dealt with have the last section of vein M_{1+2} with a fork shortly, or some distance, after the marginal cross-vein, as occurs (for example) in the two generically distinct British species, *Verrallia aucta* Fallén and *Cephalops furcatus* Egger. I agree with Collin (1945 : 2) that the primitive tendency for such a forking to occur is definitely not of generic value, especially as traces of such an appendix sometimes occur in species that normally have this section of vein M_{1+2} simple (*e.g.* a male of *Cephalops vittipes* Zetterstedt in the British Museum actually has a well-developed fork on *both wings*) ; conversely, I have seen an example of *V. aucta* which has the forking on one wing only, and another which has a second fork towards the tip of the postical cross-vein.

Hull, however, follows Enderlein (1936 : 129) in restricting *Verrallia* to those species with forked M_{1+2} (thus leaving *aucta* as the sole representative of the genus in Europe), and removing *furcatus* from *Cephalops* (as *Pipunculus*) on account of its forked vein and placing it in *Cephalosphaera* Enderlein. Hull goes further in erecting a new subfamily Nephrocerinae to include *all* Pipunculidae with the forked vein (irrespective of sound generic distinctions), leaving all those lacking such a fork in the Pipunculinae. The arguments in support of this suggested rearrangement are not at all convincing, and it can hardly be credited that it will be adopted by students of the family. Finally, in quoting Collin (1931*b* : 52) as considering the forked media as a *generic* character of his (Collin's) genus *Protonephrocerus*, Hull misconstrues Collin's meaning, for it is clear that the latter simply quoted this particular feature as being *shared* by *Nephrocerus*. Aczél (1948) deals extensively with fossil forms.

Nomenclature

The nomenclature of this family has been the subject of much controversy. From Coquillett (1910 : 535) until quite recently supporters of Meigen's 1800 names have used the family name of Dorilaidae with the type genus *Dorilas*

Meigen (1800 : 31), while common usage for the past one hundred and sixty years has been of the family name of Pipunculidae with the type genus *Pipunculus* Latreille (1802 : 463). Smart (1951 : 148–9) applied to the International Commission on Zoological Nomenclature for the suppression of the name *Dorilas* in favour of the name *Pipunculus*. Sabrosky (1952) originated the proposal that Meigen's disputed work of 1800 should be suppressed in its entirety, and in 1963 (*Bull. zool. Nomencl.* **20** : 339, Opinion 678) the Commission ruled that "the pamphlet published by J. W. Meigen, 1800, entitled *Nouvelle Classification des Mouches à Deux Ailes*, is hereby suppressed for the purposes of zoological nomenclature".

Regarding the usage of certain generic names proposed by Aczel (1939*a*, 1939*b* and 1940) and by earlier authors, these were discussed in detail by Collin (1945), and his conclusions have been adopted *in toto* in the present work.

Classification

The classification adopted in the present work is that of Collin (1945), and differs in many respects from that of Enderlein (1936), Aczel (1939*a*, 1939*b* and 1940), Carpenter & Hull (1939), and of Hardy (1943). Apart from Collin, the above authors agreed in considering the forking of the last section of wing vein M_{1+2} after the marginal cross-vein as having at least generic value, and new genera and in one case a new subfamily (see under *Fossil Pipunculidae*) were created on that basis. So far as the British fauna is concerned, three species normally exhibit this forking, *Verrallia aucta* Fallén, *Cephalops furcatus* Egger and *C. germanicus* Aczel, and there appears to be little doubt that they are correctly placed in the present arrangement.

Tomosvaryella Aczel has been shown by Collin (1945 : 3–4) to be a synonym of *Alloneura* Rondani. Hardy (1943 : 55) places the genus *Eudorylas* Aczel as a subgenus of *Pipunculus* s. str. (as *Dorilas* Meigen), his stated reasons for this step being the difficulty in checking the relevant character of the absence in *Eudorylas* of the propleural fan of hairs that are present in *Pipunculus* and the apparent lack of consistent supporting characters. I agree entirely with Collin that the distinction (which shows no signs of gradation) must be one of considerable taxonomic importance, and that *Eudorylas* deserves generic rank.

Hardy (1943 : 54) places *Cephalops* Fallén as a synonym of *Dorilas* Meigen (now *Pipunculus* Latreille) and later (1964*a* : 303) gives as the reason for this step his belief that the difference in the nature of the thoracic vestiture distinguishing the species of these two genera (i.e. *Cephalops* having the hairs on the disc of the thorax confined to two dorsocentral lines, whereas in *Pipunculus* s. str. the setae are scattered uniformly over the disc) is rather trivial, although of some specific value. Collin (1956 : 155) keys *Cephalops* as a distinct genus, although later in that paper (p. 163) he states that "the chief character separating species of this genus *or subgeneric group* (*Cephalops*), from those of *Pipunculus* s. str., is the restriction of the hairs on the thoracic disc to two uniserial rows." The fact that *Cephalops* and *Pipunculus*, so far as I have found from existing host records, each parasitizes a separate subfamily of Homoptera, would appear to support their standing as distinct genera.

General Notes on the Keys

1. Wing length has been measured with dividers from the basicosta to

the wing tip.

2. In ascertaining the colour of pubescence on body and legs (*i.e.* whether dark or light) it is helpful to view these against a dull black background, and in this respect an oblong slip of the reverse side of a carbon paper stuck on to stiff card is ideal.

3. When a specimen appears paler than it should be for a particular species, this is often due to its teneral condition ; indicating this are the somewhat translucent and crumpled wings and eyes with sunken areas. True leg-darkening in such examples can usually be ascertained by tilting the specimen to various angles.

4. It should be borne in mind that body-dusting can easily be rubbed off during the life of the adult Pipunculid, and this results in shining patches (usually irregular) being present in some species on normally dull dusted areas, *e.g.* in *Cephalops*.

5 In some instances the head may be pressed so closely against the thorax that the presence or absence of the propleural fan of hairs cannot be ascertained with certainty. In such cases it is quite unsafe to attempt to ease back the head, as the latter will probably spring off and be lost. The proper procedure is gently to detach the head over a sheet of white paper by steady pressure with a needle or pin, and to refix it after examination has been made (see also under *Collecting and Preparation*).

6. The comparative lengths of abdominal tergite five and segment eight are frequently used in the keys, and this estimate is taken with the latter segment in its normal position, and allowance must be made when it has obviously been pulled out or extended.

7. With regard to the dates given as the flight period of a species, it may be generally assumed that the "peak" period of flight is about midway between the months quoted.

8. All British material included in the keys has been identified by myself, with the exception of a few specimens in the collection of Mr. J. E. Collin.

9. All available types were examined by Mr. Collin or myself before adopting the names used for our British species.

10. When describing new species, I have in some instances, in addition to the holotype and paratypes, designated certain examples as "Other Material" ; the latter are specimens that are definitely that particular species, but, being imperfect, may not clearly present all the key characters.

11. If in doubt of the precise meaning of any specialized term used, the reader should refer to the Introduction to the Diptera, by Mr. H. Oldroyd, which forms Part 1 of volume IX of the *Handbooks*.

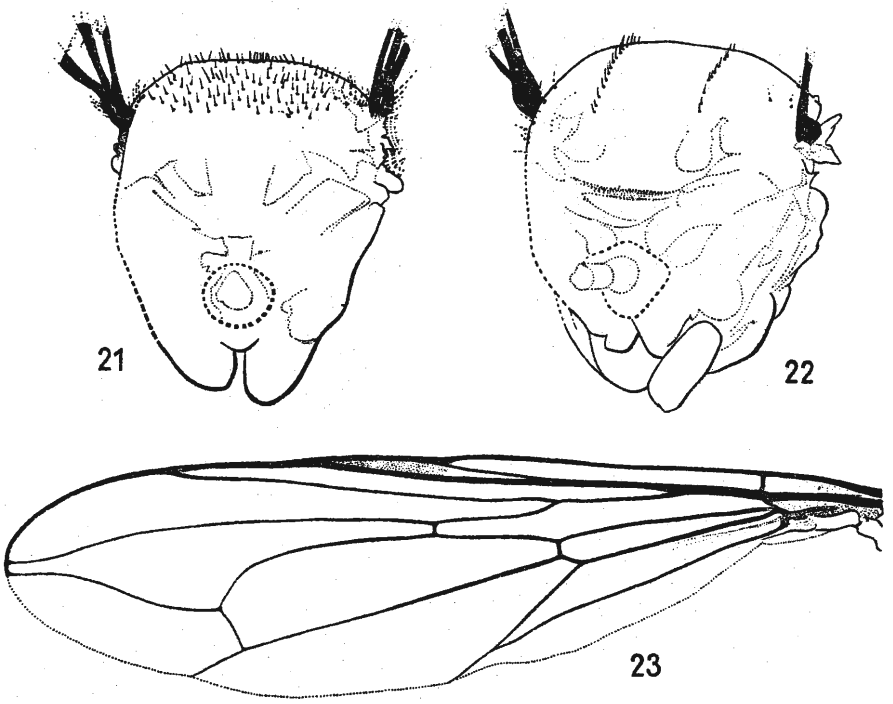
ACKNOWLEDGEMENTS

I am grateful to all those, at home and overseas, who have allowed me to examine material from collections in institutions or from their private collections. Records of particular importance are individually acknowledged in the text.

My thanks are also expressed to the Royal Irish Academy and to the British Ecological Society for their respective grants towards the expenses of my collecting journeys to Ireland, made in 1952 and 1960. Irish records mentioned in these keys are mainly the fruits of these two journeys.

The photograph of the ovaries of a Pipunculid, which forms the frontispiece, is the copyright of the Trustees of the British Museum, who have kindly

allowed me to reproduce it. My friend, Mr. C. O. Hammond, has generously drawn the cover illustration. The other illustrations have been made by Mr. A. D. Palmer, with the exception of figs. 6–8, 33–53, 102–4, and 128–30. which are the work of the author.



FIGS. 21–23.—21–22. Thorax, from front, showing hair arrangement. 21, *Pipunculus thomsoni*; 22, *Eudorylas zonellus*. 23. *E. zonellus*, wing.

KEY TO SUBFAMILIES AND GENERA

1 Ocellar bristles present; occiput in profile not, or scarcely, projecting beyond eyes; more hairy species (CHALARINAE) 2
– Ocellar bristles absent; occiput more or less prominent in profile; usually not densely haired species 3
2 Discal cell of wing (fig. 18) open at end, no outer cross-vein **Chalarus** Walker (p. 24)
– Discal cell (figs. 15, 16) closed by a cross-vein ..... **Verrallia** Mik (p. 31)
3 A deep excision in hind margin of eye; thorax and scutellum with strong marginal bristles; very large species; wing (fig. 14). (NEPHROCERINAE sensu Hardy, 1943 : 25, nec Hull, 1939 : 9) ..... **Nephrocerus** Zetterstedt (p. 34)
– No distinct hind marginal excision of eye; thorax and scutellum without strong bristles; never very large species (PIPUNCULINAE) 4
4 No coloured stigma present below costa of wing (figs. 17, 19) 5
– A coloured stigma present (figs. 15, 16, 18, 23) 6
5 *R–M* (fig. 19) at about middle of discal cell. ♂ eyes touching on frons (in British species) ..... **Alloneura** Rondani (p. 37)
– *R–M* (fig. 17) towards base of discal cell. ♂ eyes separated on frons, sometimes only extremely narrowly ..... **Dorylomorpha** Aczel (p. 40)
6 Thorax (fig. 21) universally hairy on disc; propleural fan of hairs (fig. 25) present; wing (fig. 1) ..... **Pipunculus** Latreille (p. 47)

– Thorax (fig. 22) with very small hairs in two dorsocentral lines, the area between these bare 7
7 Propleural fan of hairs (fig. 20) present ; usually more shining species ; body never entirely dull ; wing (fig. 24) ..... **Cephalops** Fallén (p. 54)
– No propleural fan of hairs (fig. 26) ; usually very dull brownish or brownish-black species ; wing (fig. 23) ..... **Eudorylas** Aczel (p. 64)

Genus **Chalarus** Walker

Until 1956, when Collin (p. 155) introduced *latifrons* Hardy as British, *spurius* Fallén was the only species of *Chalarus* recorded as occurring in this country. Recently, however, (1966 : 149) I raised the number of our species

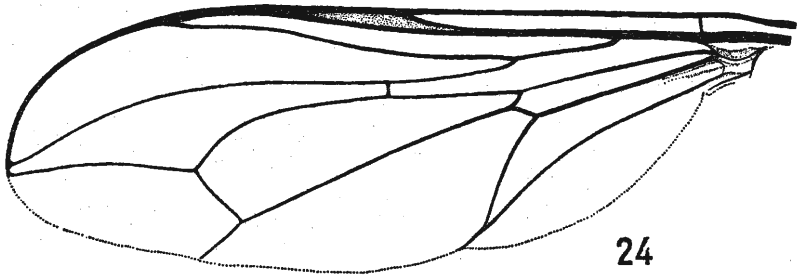
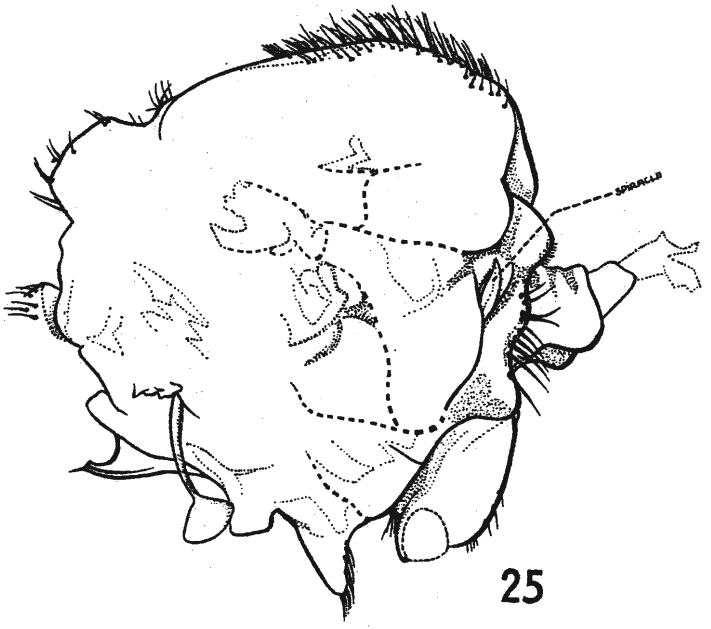


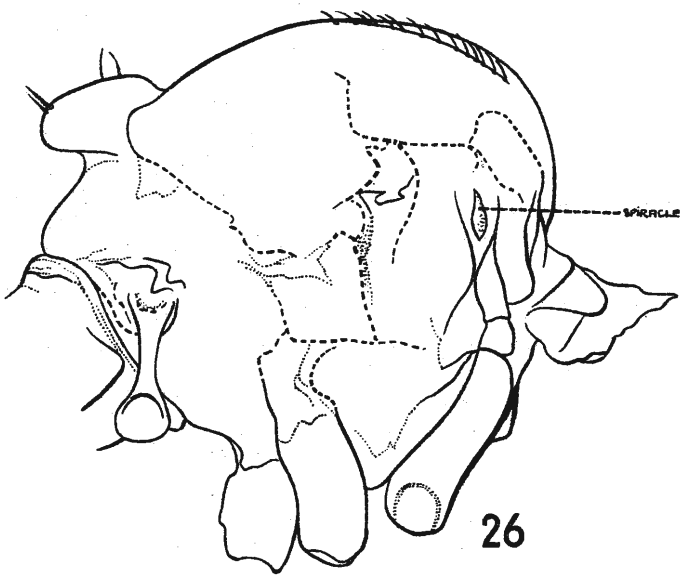
FIG. 24.—*Cephalops semifumosus*, wing.

to nine, five of these being described as new to science (*fimbriatus*, *griseus*, *pughi*, *argenteus* and *parmenteri*) ; it is possible that the male of *griseus* Coe may in course of time prove to belong to the same species as one of the three that I described from the female only. There is little doubt that further species remain to be discovered here.

The remarkable degree of similarity in external characters in this genus makes the separation of species a difficult matter, and the frequency of sexual dimorphism coupled with the extreme rarity of the capture of mated pairs renders it no easy matter correctly to associate the sexes. In the females the body is sometimes of lighter coloration than in the males, its pubescence tending to be shorter and scantier ; the pulvilli are often much longer, while the front eye-facets are moderately to considerably enlarged, these being only slightly enlarged in the males. In all known *Chalarus* the axillary wing lobe is only moderately developed in the male and absent in the female.

Males of the common *spurius* sometimes occur in considerable numbers flying at a few feet from the ground around various trees, particularly birch, while the females of this species (and of others in my experience) are infrequently met with. However, in August 1964 Dr. E. Burtt took a long series of both sexes momentarily settling on the upper surface of hazel leaves in a coppice, and similarly on nettle leaves ; none was observed in copulation. Observations of parasitism by *Chalarus* are infrequent, and in those of which I am aware the host Homopteron has belonged to the subfamily Typhlocybinae of the Cicadellidae. Giard's and Keilin and Thompson's records that follow may not refer to the true *spurius*. Giard (1889 : 708–10) discussed the parasitism by *C.* (as *Atelenevra*) *spurius* of *Facocyba cruenta* Herrich-



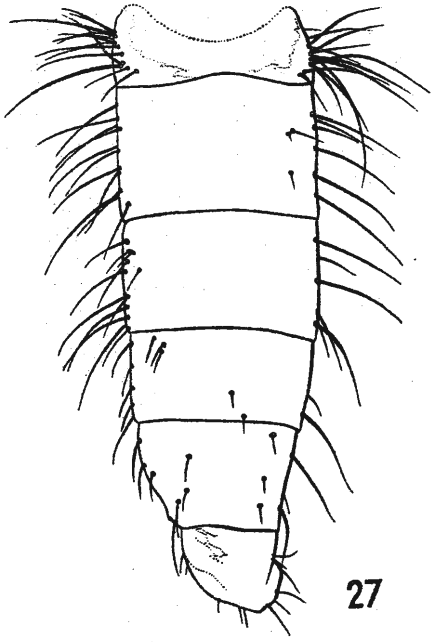


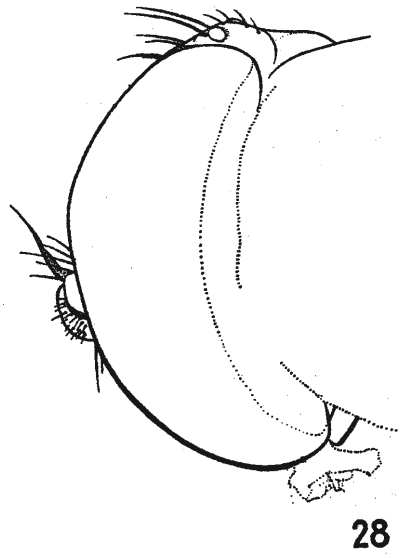
FIGS. 25–26.—Thorax, from side, showing presence or absence of propleural hair fan. 25, *Pipunculus thomsoni*; 26, *Eudorylas zonellus*.

Schaeffer (as *Typhlocyba douglasi* Edwards J.) and *Typhlocyba* (*Edwardsiana*) *hippocastani* Edwards J. Keilin and Thompson (1915 : 9–12) bred *spurius* from several *Typhlocyba* spp. Professor O. W. Richards (unrecorded) bred *spurius* from *Eupteryx notatus* Curtis, the Pipunculid larva leaving the body of its host on 13th June, pupating 14th June, and the adult *spurius* emerging on 13th July. Lundbeck (1922 : 61) bred *Chalarus* sp. from pupae found in hollow trees and in flood refuse in spring, while Mr. E. B. Basden (unrecorded) bred *C. spurius* from a puparium found in a bird's nest, the adult fly emerging in May. Blair (1943 : 129) records the interesting fact that he bred a specimen of *spurius* from a puparium found with paralysed Typhlocybinae in the burrows of a Crabronid wasp in the rotten wood of an old beech tree.

The true identity of *Chalarus holosericeus* Meigen (1824 : 24) has hitherto been doubtful, but recently Dr. T. Tsacas has kindly confirmed for me that the sole specimen labelled (in longhand) as "*P. holosericeus* ♀" in the Museum national d'Histoire naturelle, Paris, has the mid femora with the postero-ventral fringe composed of black hairs, a character peculiar to *spurius* Fallén.

Chalarus exiguus Haliday (1833 : 162) must be regarded as a *species incertae sedis*. The female example that he described was taken at Holywood in County Down, Northern Ireland, and should therefore be with that material in the collections of the National Museum of Ireland in Dublin. Several years ago, however, I searched for it there without success, and more recently the curator of insects, Miss Geraldine Roche, made a further fruitless search on my behalf. Haliday's original description is quite inadequate as the means of recognition.





FIGS. 27–28.—27, *Chalarus fimbriatus* ♂, tergites, from above. 28, *C. latifrons* ♂, head, in profile, showing ocellar and frontal bristles.

KEY TO SPECIES

1 Mid femora with a posteroventral fringe (fig. 29) of black or brownish long curved bristly hairs ; legs dark ; wing length 2·5–3·5 mm. ♂ viewed from above, thorax and scutellum intense black, moderately shining, tergites dull greyish- or blackish-brown ; mid femoral fringe composed of about 18–22 bristly hairs ; hypopygium (figs. 33, 34). ♀ viewed from above, thorax and scutellum greyish-black, shining, tergites lighter brownish-grey, less shining ; abdominal segment 6, variation (fig. 40) ; mid femoral fringe composed of about 12–16 bristly hairs, which are finer, slightly shorter and inclined to be brownish rather than black; ovipositor (figs. 41, 42).....**spurius** Fallén.

Frequent and generally distributed throughout the British Isles. iv–ix (see Coe, 1966, for fuller redescription of both sexes and notes on variation and synonymy).

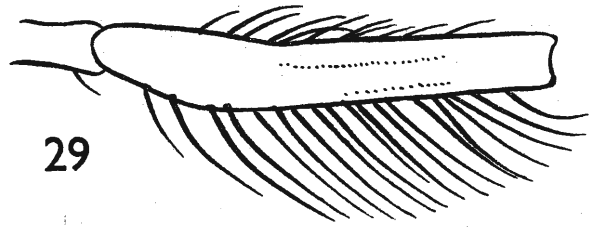
– Mid femoral fringe composed of whitish (or, *griseus* ♂, very pale golden) bristly hairs (view immediately from above).....2

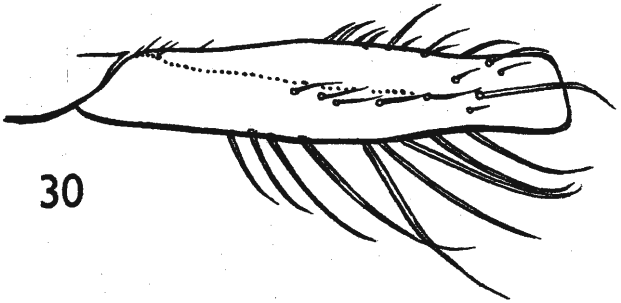
2 Hind femora with the last (uppermost) of the 5–8 long strong whitish curved bristles arranged fan-like along the anterior and dorsal surfaces placed *absolutely along the mid-dorsal line* (fig. 30) ; wing length 3·5–4 mm. ♂ frons with one or several bristly hairs (in pairs or scattered) anterior of the pair of long ocellar bristles (fig. 28) ; mid femoral fringe composed of about 24–28 mainly close-set long curved bristly hairs ; hypopygium (fig. 35). ♀ mid femoral fringe composed of about 18–20 bristly hairs, less close-set and slightly shorter than in ♂ ; front and mid pulvilli about 1¼ times as long as last tarsal segment, hind pulvilli rather more than half as long as last tarsal segment ; ovipositor (fig. 43)

latifrons Hardy

Inverness., Moray., Angus, Cumberland, Lancs., Yorks., Stafford., then generally distributed in south-east and southern England. v–ix (see Coe, 1966 : for fuller redescription of both sexes).

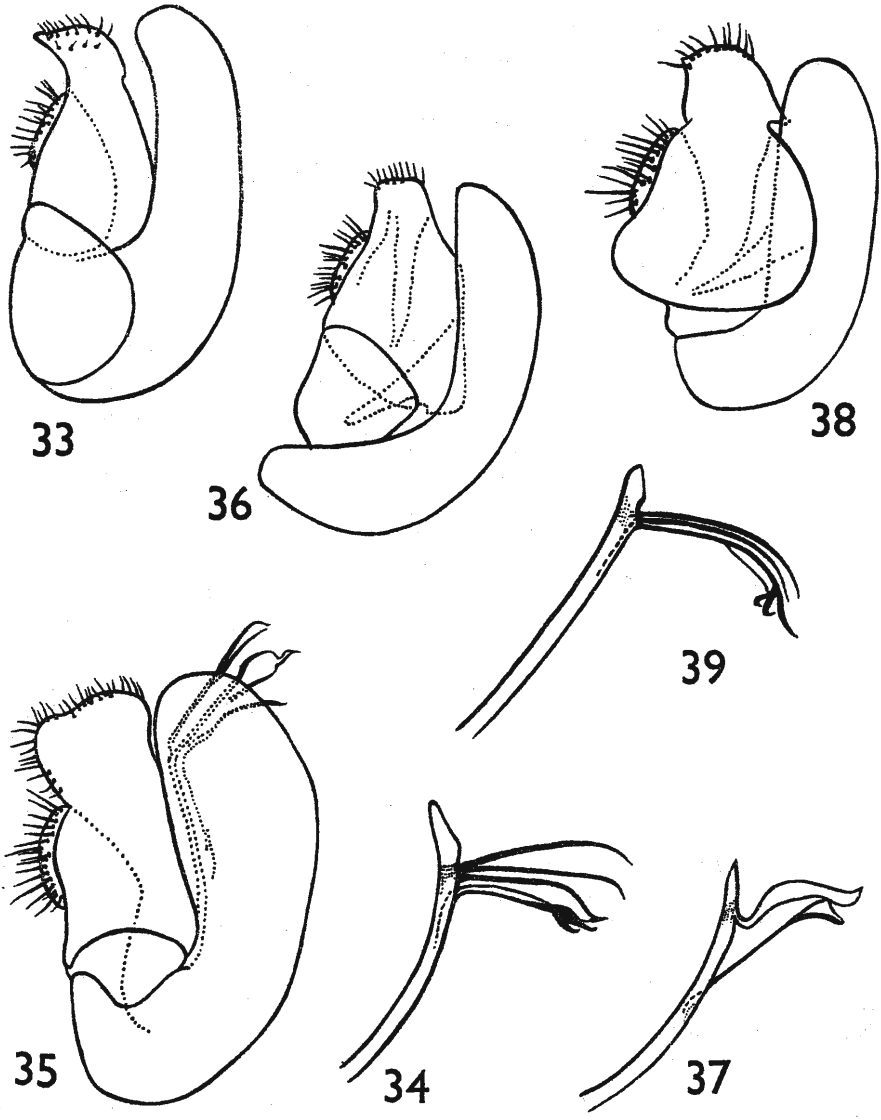
– Hind femora with the last (uppermost) of the long curved bristles *not* placed mid-dorsally, although sometimes anterodorsally ; frons normally devoid of bristles or bristly hairs (one or more occasionally present in *fimbriatus* ♂) anterior of the pair of long ocellar bristles ; mid femoral fringe composed of at most 20 bristly hairs 3





FIGS. 29–32.—29, *Chalarus spurius* ♂, mid femur, showing posteroventral hair fringe. 30, *C. latifrons*, hind femur, showing middorsal bristle towards tip. 31–32, *Chalarus* ♀, front tarsus, showing pulvilli and claws. 31, *pughi* ; 32, *fimbriatus*.

3 Males 4
– Females 5
4 Frons at level of antennae at most as wide as at level of front ocellus, usually less so ; abdomen (fig. 27) quite narrow ; legs with at least tarsi pale ; leg bristles and hairs pale; wings more or less distinctly brownish tinged ; smaller species ; wing length 2·75–3·5 mm ; hypopygium (figs. 36, 37)..... **fimbriatus** Coe ♂



FIGS. 33–39.—*Chalarus*, various parts of male hypopygium, in profile. 33, 35, 36, 38 : styles (aedeagus removed except in 35). 33, *spurius* ; 35, *latifrons* ; 36, *fimbriatus* ; 38, *griseus*. 34, 37, 39 : upper part of aedeagus. 34, *spurius* ; 37, *fimbriatus* ; 39, *griseus*.

Holotype ♂ : *Surrey* (*Selsdon Wood*), *flying over leaves of Elder*, 22.v.1961, *R. L. Coe*. Paratypes : data as holotype, 4 ♂, 1 ♀. Other Material : *Inverness., Banff., Dunbarton., Lancs., then frequent and generally distributed in south-east and southern England. S. Ireland, Co. Wicklow. v–ix.*

– Frons at level of antennae over one and a half times as wide as at level of front ocellus ; abdomen broad ; legs entirely greyish-black ; leg bristles and hairs mainly dark ; mid femoral fringe very pale golden ; wings clear ; larger species ; wing length 3·5 mm. ; hypopygium (figs. 38, 39)....**griseus** Coe ♂ (♀ unknown)

Holotype ♂ : *Kent* (*Sevenoaks*), 4.vii.1965, *L. Parmenter*.

5 Front and mid pulvilli (fig. 31) almost twice as long as last tarsal segment, hind pulvilli shorter than last segment.....6

– All pulvilli (fig. 32) at most as long as last tarsal segment, and usually shorter.....7

6 Ovipositor with base shallow, long and narrow, more than twice as long as wide ; piercer about as long as base, rather strongly curved ; wing length 3·25 mm.

Aberdeen. (*Balmoral Forest*), 19–30.vii.1938, *R. L. Coe*, 1 ♀. (Since these key characters were written, this unique example suffered damage and I have therefore retained it as " sp. " only).....**sp.**

– Ovipositor (fig. 44); viewed posteroventrally *in situ*, base is deeper, more convex and shorter, only slightly longer than wide ; piercer about one and a half times as long as base, strongly curved ; front pulvilli and claws (fig. 31)

pughi Coe ♀ (♂ unknown)

Holotype ♀ : *Surrey* (*Selsdon*), 6.vi.1938, *R. L. Coe*. Paratypes : *Dunbarton.* (*Bonhill*), 20.viii.1908, *J. R. Malloch*, 1 ♀ ; *Cambridge.* (*Chippenham*), 13.vi.1965, *L. Parmenter*, 1 ♀ ; *Wilts.* (*Marlborough*), 1914, *T. Kirkpatrick*, 2 ♀ ; *Devon.* (*Torquay*), 19.vi.1960, *J. R. Vockeroth*, 1 ♀. Other Material : *Shropshire, Bucks., Berks., Surrey, Sussex. vi–viii.*

7 Abdomen with tergites 1 and 2, and sometimes base of 3, pale yellowish, this coloration usually extending over lateral and ventral surfaces of basal segments to some extent ; remainder of tergites, viewed from above, greyish-black, shining, and from same viewpoint thorax and scutellum both appear moderately light grey, slightly shining ; ovipositor (in profile, fig. 45) ; viewed posteroventrally *in situ* base is semispherical, shining black, lightly dusted ; piercer about one and a half times as long as base, moderately curved, mainly clear yellow : legs yellow, except that coxae and tibiae may be vaguely obscured ; wing length 3 mm.

basalis Loew ♀ (♂ not recorded in Britain)

Moray. (*Culbin Sands*), 5–7.vii.1936, *R. L. Coe*, 1 ♀ ; *Hereford.* (*? Coldbrook Point*), 3.vi.1904, *J. H. Wood*, 1 ♀ (see Coe, 1966 : for fuller redescription).

– Tergites completely silvery-grey, grey or greyish-black.....8

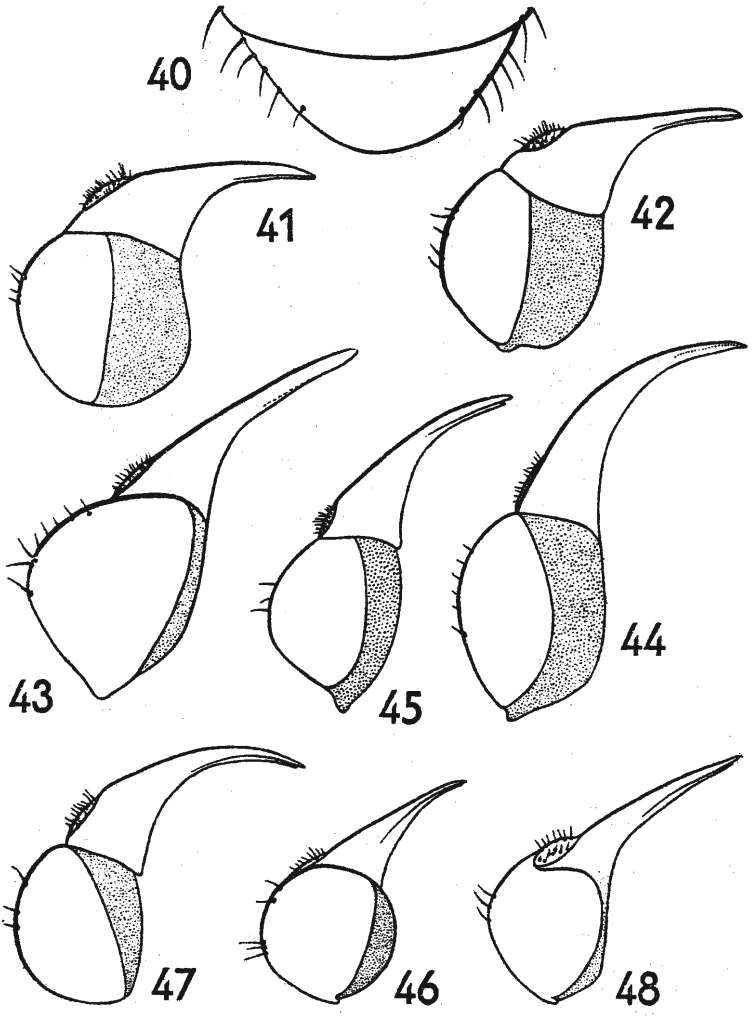
8 Whole body light silvery-grey (from all angles) ; ovipositor (in profile, fig. 46) ; small, base semispherical (viewed posteroventrally *in situ*), shining black, very lightly dusted ; piercer about one and a half times as long as base, very slightly curved downward except towards apex, yellow to dark reddish ; legs greyish-black ; wing length 2·5 mm.....**argenteus** Coe ♀ (♂ unknown)

Holotype ♀ : *Ireland* (*County Wicklow, Killoughter*), *flying amongst branches of Sycamore*, 11.vi.1953, *R. L. Coe*. Paratype ♀ : *Berks.* (*Wytham*), *emerged from soil under Oak*, 2.vii.1951, *G. C. Varley*.

– Body partly or entirely darker.....9

9 Frons rather wide, at narrowest point about half as wide as at level of front ocellus ; front eye-facets only moderately enlarged (less than in remaining (known) females of British species) ; thorax and scutellum dull grey with a slight satiny sheen (from all angles) ; scutellum on actual disc with only scattered weak pale hairs ; tergites greyish-black, moderately shining ; ovipositor (in profile, fig. 47); base shortly semi-oval (posteroventrally viewed *in situ*), brilliantly polished black, slightly dusted ; piercer about one and a half times as long as base, quite strongly curved ; front pulvilli and claws (fig. 32). (Wing length, distribution and dates, see ♂).....**fimbriatus** Coe ♀

– Frons narrow, at narrowest point less than one third as wide as at level of front ocellus ; front eye-facets very considerably enlarged ; viewed from above, thorax greyish-black or even darker, slightly shining, and scutellum dull, with black ground colour more or less heavily obscured with brownish-grey dusting, latter on actual disc with some conspicuous upstanding fairly long dark bristles ; from same viewpoint, tergites dull greyish-brown ; ovipositor (in profile, fig. 48) ; base semispherical (posteroventrally viewed *in situ*), brilliantly polished black



FIGS. 40–48.—40, *Chalarus spurius* ♂, abdominal segment 6, variation. 41–48, *Chalarus*, female ovipositor. 41–42, *spurius* (41, typical; 42, variation). 43, *latifrons*; 44, *pughi*; 45, *basalis*; 46, *argenteus*; 47, *fimbriatus*; 48, *parmenteri*.

and very slightly dusted; piercer quite twice as long as base, slightly curved; wing length 2·5–2·75 mm.....**parmenteri** Coe ♀ (♂ unknown)

Holotype ♀: *Dunbarton.* (*Bonhill*), 10.vii.1909, *J. R. Malloch.* Paratypes: same data as holotype, 2 ♀; *Westmorland* (*Witherslack*), 5.vii.1946, *A. Brindle*, 1 ♀; *Cheshire* (*Cotterill Clough*), 14.vi.1949, *H. Britten*, 1 ♀; *Surrey* (*Bookham*), 26.vi.1960, *L. Parmenter*, 1 ♀. Other material: *Surrey* (*Oxshott*), 9.vi.1940, *L. Parmenter*, 1 ♀; *Kent* (*Tunbridge Wells*), viii.1922, *C. G. Nurse*, 1 ♀; (*Sevenoaks*), 4.vii.1965, *L. Parmenter*, 1 ♀.

Genus **Verrallia** Mik

In Britain this genus is represented by five species, all of medium size, with wing lengths varying from 4 to 5·5 mm. When collecting on a warm dry summer day among brambles edging woodlands one frequently finds *Verrallia aucta* occurring in numbers. Verrall (1901 : 76) noted that his nephew, Mr. J. E. Collin, saw the males of *aucta* in swarms at Chippenham Fen, flying rather steadily about seven feet from the ground over pathways, while the females appeared to keep close to the ground. I have observed *aucta* behaving similarly over a path at the fringe of Selsdon Wood in Surrey. The remaining species of the genus occur less commonly in suitable situations.

The few published records of the breeding habits indicate that parasitism by *Verrallia* is confined to Homoptera of the family Cercopidae, including our common froghopper, *Philaenus spumarius* L. It is interesting that *Verrallia* is the only genus of Pipunculidae recorded as attacking the adult Homopteron to the exclusion of the nymphal stages (for more details, see under *Life History*). Breeding records of British species examined by myself are as follows : *V. aucta*, Arran (Corrie), bred from larvae occurring in adult females of *Philaenus spumarius* L. (Cercopidae), larvae emerged from hosts 5–6.ix, adults emerged 26–28.v. of following year, J. Waterston ; parasitizing adult froghoppers (Cercopidae), F. Jenkinson (1903 : 222). *V. pilosa* Zetterstedt, Buckingham. (Medmenham), bred from puparium in bird's nest, adult emerged 17.v, E. B. Basden.

Collin (1931*a*) redescribed the four species of *Verrallia* then known as British, and to these I recently (1966 : 159) added *beatricis* as new to science.

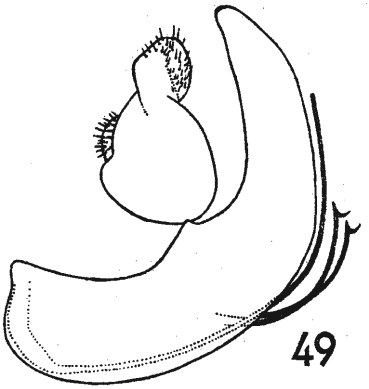
Key to Species

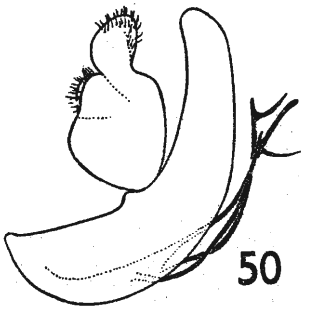
1 Wing (fig. 16) with last section of M_{1+2} with a fork soon after the marginal cross-vein, this fork extending for about half or slightly more of the distance between its base and the wing margin ; all femora without a wart beneath ; wing length 4–5 mm. ♂ hypopygium (fig. 51). ♀ pulvilli very long, with a satiny sheen ; ovipositor, see Harris (1966 : fig. 1) ..... **aucta** Fallén
Common and generally distributed. v–viii.

– Last section of M_{1+2} without a fork 2

2 Males 3

– Females 6





Figs. 49–50.—*Verrallia*, male hypopygium. 49, *pilosa* ; 50, *beatricis*.

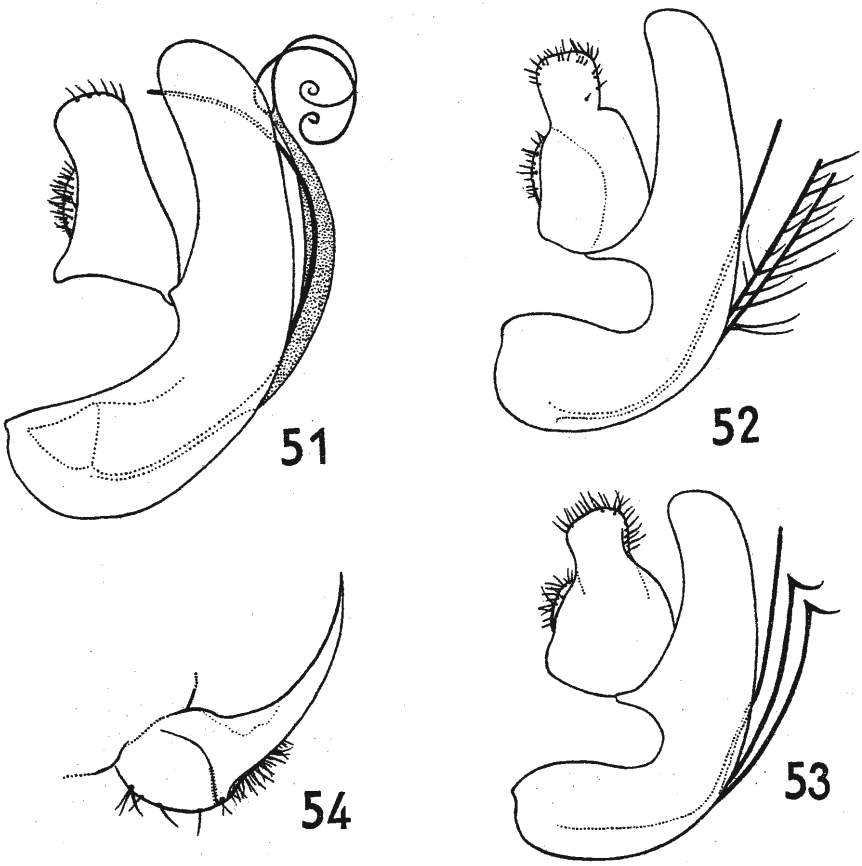
3 All femora without a wart beneath ; all bristles, body pubescence and femoral fringes brownish or black; scutellum with 6–8 strong marginal bristles; wing (fig. 15) ; wing length 5–5·5 mm. ; hypopygium (fig. 52)....**villosa** von Roser ♂
Generally distributed. v–viii.

– Four anterior femora with a distinct wart beneath, hind pair with at least a trace of such a wart.....4

4 All bristles, body pubescence and femoral fringes brownish or black ; second antennal segment dark brownish haired beneath ; scutellum with 8–10 strong marginal bristles ; wing length 4·5–5·25 mm. ; hypopygium (fig. 53) **setosa** Verrall ♂
Generally distributed. iv–vii.

– First abdominal tergite with lateral tufts of long whitish bristles ; second antennal segment pale haired beneath ; mid femora with a posterior fringe of pale hairs and hind femora with an irregular anterior fringe of long partly pale hairs ; scutellum with only 4–6 strong marginal bristles.....5

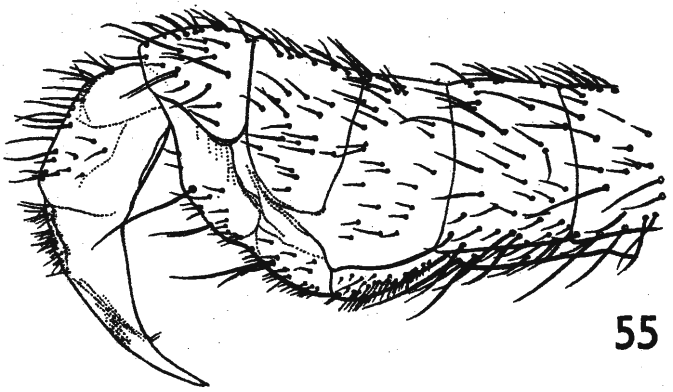
5 Thorax dull black, usually with trace only of greyish median stripes when viewed from front ; tergites dull black, often tinged brownish and from front view the first two or three on disc are more or less densely streaked transversely with chocolate-brown dusting, succeeding tergites only lightly, if at all, dusted, so that the dullish black ground colour is apparent ; tergites 1–4 from posterolateral view

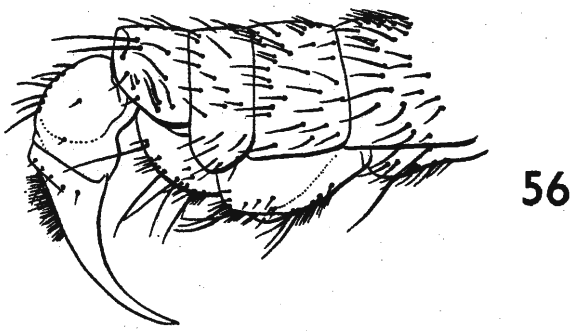


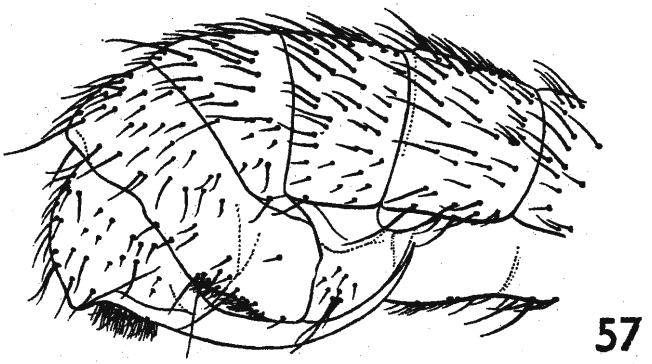
FIGS. 51–54.—51–53. *Verrallia*, male hypopygium. 51, *aucta* ; 52, *villosa* ; 53, *setosa*. 54, *V. setosa*, female ovipositor.

with bluish-grey side markings not nearly occupying length of tergites, those on tergites 2–4 appearing subtriangular from posterolateral view ; femoral wart large and conspicuous on four anterior legs, small but distinct on hind pair ; wing length 4–4·5 mm. ; hypopygium (fig. 49).....**pilosa** Zetterstedt ♂
Sutherland., Inverness., Aberdeen., N. Lancs., Cheshire, Stafford., Warwick., Cambridge., Oxford., Wilts., Berks., Hants, Surrey, Kent. vi–vii. (See Coe, 1966: for fuller redescription.)

– Thorax dull black, from front view with conspicuous heavy chocolate-brown and grey dusting, arranged more or less in two or four broad stripes which merge anteriorly ; tergites dullish black from above, from front view heavily dusted







FIGS. 55–57.—*Verrallia*, female ovipositor. 55, *villosa* ; 56, *beatricis* ; 57, *pilosa*.

with transverse streaks of chocolate-brown, which are generally distributed ; tergites 1–4 from posterolateral view have larger and more conspicuous light silvery-grey lateral markings, occupying almost entire length of tergites, those on tergites 2–4 not appearing subtriangular from posterolateral view ; femoral wart quite small on four anterior legs, and scarcely discernible on hind pair ; wing length 4·5–5 mm. ; hypopygium (fig. 50).....**beatricis** Coe ♂

Holotype ♂ : *Hereford.* (*Stoke Wood*), 30.v.1904, *J. H. Wood.* Paratypes : *Lancs.* (*Lytham*), 10.vii.1948, *H. Audcent*, 1 ♂ ; *Norfolk* (*nr. Barton Broad*), 22.vi.1937, *L. Parmenter*, 1 ♀ ; *Hereford.* (*West Hide*), 9.vii.1899, *C. J. Wainwright*, 1 ♀ ; *Oxford.* (*Shotover*), 1.vii.1917, *H. Audcent*, 1 ♀ ; *Somerset* (*Backwell*), 11.vii.1925, *H. Audcent*, 1 ♂ ; *Middlesex* (*Hampstead*), 8.vii.1925, *O. W. Richards*, 1 ♀ ; *Hants.* (*New Forest*), vi.1902 and vii.1904, *D. Sharp*, 2 ♀, 10.vii.1900 and 1.vii.1905, *F. C. Adams*, 2 ♀, 6.vii.1897, *J. W. Yerbury*, 1 ♀ ; *Sussex* (*Crowborough*), 27.vi.1903, 28.vi.1904, 16.vii.1912, *F. Jenkinson*, 3 ♀. Other Material: *Berks.* (*Checkendon*), 30.vi.1964, *E. Burtt*, 1 ♀. *v–vii.*

6 Pulvilli very long, at least twice as long as last tarsal segment ; all femora with a trace of a wart beneath ; hairs beneath second antennal segment pale and those on anterior part of thorax usually so, other body pubescence rather variable in colour ; scutellum with 6–8 strong marginal bristles ; ovipositor (fig. 55) much longer in proportion to its width than in *setosa*, *pilosa* and *beatricis*. (Wing length, distribution and dates, see ♂).....**villosa** von Roser ♀

– Pulvilli at most only moderately longer than last tarsal segment.....7

7 Second antennal segment with rather long dark hairs below ; pulvilli not longer than last tarsal segment ; front eye facets only moderately enlarged ; scutellum with 8–10 strong marginal bristles ; four anterior femora with a small wart beneath, none present on hind femora ; ovipositor (fig. 54). (Wing length, distribution and dates, see ♂).....**setosa** Verrall ♀

– Second antennal segment with long pale hairs below ; pulvilli at least slightly longer than last tarsal segment ; front eye facets considerably enlarged ; scutellum with 4–6 strong marginal bristles ; all femora with at least a small wart below 8

8 Ground colour of thorax appears medium grey when viewed from above ; abdomen rather narrow ; tergites with lightish grey ground colour, 1 usually entirely so, 2 with a brownish area (usually confined to disc), 3–5 with a broad blackish band occupying at least on disc anterior two-thirds of tergite, gradually narrowing laterally, 6 more or less brownish on disc ; ovipositor (fig. 57) with base roundish, quite strongly convex, the sparse grey dusting leaving the shining blackish-grey ground colour exposed, piercer long and thick, strongly upcurved, reaching beyond tip of third sternite ; legs with coxae and trochanters greyish-black; femora greyish-black, narrowly yellow tipped ; tibiae greyish-black, narrowly yellow at base and at extreme tip ; tarsi usually almost entirely darkened ; four anterior femora with a large conspicuous wart below near middle, and hind pair with a similarly placed small but distinct wart ; pulvilli slightly longer than last tarsal segment. (Wing length, distribution and dates, see ♂, and see Coe, 1966 : 158 for fuller redescription).....**pilosa** Zetterstedt ♀

– Ground colour of thorax appears light grey from above ; abdomen broader than in *pilosa* ♀ ; tergites with patterning resembling *pilosa* ♀, but with marked tendency for ground colour to be silvery-grey and dark markings more restricted, especially towards sides ; ovipositor (fig. 56) smaller, base roundish but less strongly convex, the greyish dust rather heavier, so that the shining blackish-grey ground colour is inclined to be obscured, piercer less thick than in *pilosa* ♀, quite long, but barely reaching back to tip of third sternite, strongly upcurved ; coxae and femora greyish-black as in *pilosa* ♀, but trochanters inclined to be yellowish ; tibiae and tarsi entirely yellowish, or more or less extensively obscured ; all femora with a small wart beneath near middle ; pulvilli rather longer than in *pilosa* ♀. (Wing length, distribution and dates, see ♂, and see Coe, 1966 : for original description) **beatricis** Coe ♀

Genus **Nephrocerus** Zetterstedt

Flies of the genus *Nephrocerus* are the largest of the Pipunculidae, ranging in wing length from 7·0–9·5 mm. ; they may be recognized readily by the strong well-developed marginal bristles on the thorax and scutellum and the

deeply excavated hind margin of the eyes. The Reverend F. C. Adams captured the first recorded British example of *flavicornis* in 1894, and at present the total of specimens taken in this country is only 21. Since Adams' original record a single specimen has been taken on an average every seven years, with one gap of 24 years between captures (1908–32). A male example that I caught at Ashtead Woods, Surrey, in 1932 was flying low amongst grasses near scattered oak trees. The mode of flight resembles that of other Pipunculids, but in general appearance *flavicornis* could easily be mistaken for several flies of other families. The male is not unlike a male *Platycheirus* or *Melanostoma*, and the female a female *Baccha*. Fonseca (1957 : 15–16) supports this contention when he states that *flavicornis*, of which he took three males, could easily be mistaken in flight for one of the narrow-bodied species of *Platycheirus*. Morley (1944 : 169) remarks how the male that he took in his house at dusk had been resting on the window all day and he had ignored it for a common little Syrphid. Jenkinson (1903*b* : 227) kept a male alive in a pill-box for several days and noted that "it has the face of a *Psilopus* (Dolichopodidae, now *Sciopus*) and to some extent of *Baccha*". On this occasion and in 1907 (p. 14) when he captured a female he noted that the flies rested with the head close to the surface and the body curved up (the back concave) at an angle of about 30° or 45°. Laurence (1952 : 28) suggested that the species' apparent scarcity may be accounted for by the short flight period, quoting this as from the end of June until early July, but in fact a number of specimens have been captured from 12th June to 13th August. If the species is really less rare than appears to be the case at present it may well be due to its resemblance to some common flies of other families as quoted above.

The identity of the Homopteron (or Homoptera) that *flavicornis* parasitizes has been the subject of considerable speculation, and provides an interesting problem. Because of the large size of the fly it is obvious that its larva requires a host with a sufficiently capacious abdomen to allow for the full development of the parasite. When Verrall (1901 : 78) suggested in as many words that *flavicornis* may well be parasitic in its larval stage on the New Forest Cicada (*Cicadetta montana* Scopoli) only three *flavicornis* had been recorded in Britain, all from the New Forest. Verrall's idea that our largest Homopteron might be the host insect seemed feasible at a time when it appeared that both insects might in Britain be confined to that locality, and when little was known of the specialized life-cycle of the Cicada. Verrall's theory has subsequently been repeated without comment several times in the literature, *e.g.* Lundbeck (1922 : 8) and Enderlein (1936 : 128). Lindberg (1946 : 16), however, points out that the European (apparently non-British) *N. scutellatus* Macquart is recorded in the southern part of the Kola Peninsula in Finland far outside the range of *Cicadetta* (as *Melampsalta*) *montana*. He goes on to state that it therefore appears that *scutellatus* parasitizes some smaller Homopteron (or Homoptera). In view of our present knowledge that *flavicornis* likewise occurs in areas far outside the range of *C. montana*, Lindberg's contention applies definitely so far as our own *Nephrocerus* species is concerned. In Britain *C. montana* appears to be confined nowadays to a limited area in the New Forest, although I have seen a statement by Dr. E. A. Cockayne that he took the species in Endless Wood, near Chiddingfold, Surrey (footnote to Laurence, 1952 : 28). Cockayne does not give the date of his capture. Laurence (1952 : 28) and Smith (1959 : 168) have both

suggested the likely association of *flavicornis* with a more widespread, large Homopteron. Besides the difference in the locality pattern of *flavicornis* and *C. montana* there are several factors in the unusual life-history of our large Cicada that make it highly improbable that it is parasitized by the Pipunculid. Dr. W. E. China concurs with this opinion. On investigation it appears possible that our second largest Homopteron, *Ledra aurita* L., may be the true host of *flavicornis*. Besides the size factor being reasonably proportionate, the two species have a similar distribution and type of habitat. *L. aurita* is found on oaks in wooded areas, and although uncommon is fairly widely distributed from the New Forest up to Norfolk. *N. flavicornis* has a predilection for oak woods and is fairly widely distributed from the New Forest up to Suffolk.

In the following key I have included the two European species of the genus that have not been recorded in Britain, *lapponicus* Zetterstedt and *scutellatus* Macquart, as one or both of these might well be found to occur here. I have given in detail the records of *flavicornis* in this country, because the species is undoubtedly of exceptional interest.

Key to European Species

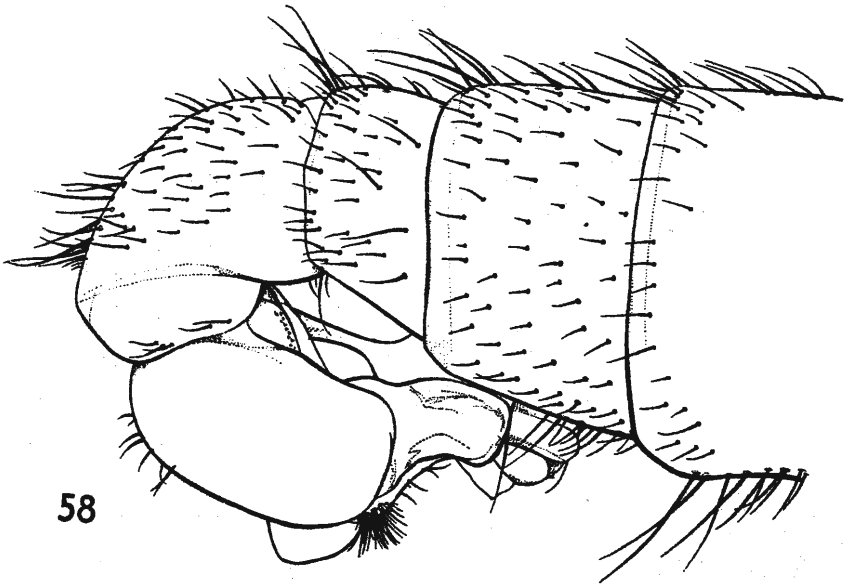
1 Last tarsal segment of all legs with several long bristly hairs ; hind tibiae noticeably bent 2

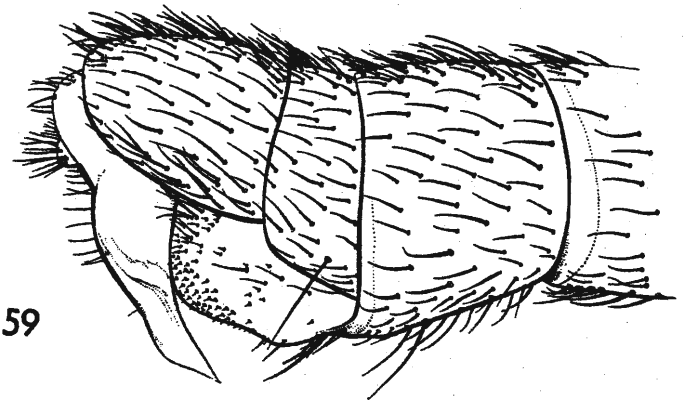
– Last tarsal segment of all legs without noticeably long bristly hairs ; hind tibiae absolutely simple ; antennae large, brown ; arista entirely black ; face without noticeably long hairs ; length 7–8 mm..... **lapponicus** Zetterstedt (not known as British, and not examined. Description from Sack (1935:10–12))
North and Central Europe.

2 Hind tibiae broadened at the tip with a fringe or circlet of stiff brown hairs, these somewhat weaker in the ♀ than in the ♂ ; antennae of medium size, entirely yellow ; arista yellow at base, remainder black, thickened for about basal third ; face with rather conspicuous silvery-grey hairs ; thorax shining black on disc, more narrowly so anteriorly and posteriorly, broadly yellow at sides, including humeri ; scutellum yellow, base sometimes brownish ; tergites brown or brownish-black, 2 and 3 with more or less broad posterior yellowish bands, these broadening laterally, sometimes very much so ; 4 and 5 sometimes with yellow posterior bands, but these narrow and not broadening laterally ; legs yellow ; wing length 7–9 mm. ♂ hypopygium (fig. 58). ♀ ovipositor (fig. 59). *vi–viii* **flavicornis** Zetterstedt

Rare, in or near woods. Cambridge. (Chippenham Fen), sweeping herbage at border of fen, 9.vii.1928, *J. E. Collin,* 1 ♂, *(Newnham),* 26.vii.1907, *F. Jenkinson* (1907:14), 1 ♀ ; *Suffolk (Monks Soham),* 12.vi.1944, *C. Morley* (1944 : 169–70), 1 ♂ ; also same locality and captor, 9.vii.1946, recorded by A. Aston (1958 : 55), 1 ♂ ; *Oxford. (Goring Heath),* 13.vi.1964, *E. Burtt,* 1 ♀ *and* 27.vi.1965, 1 ♂ ; *Buckingham. (Shabbington Wood),* 14.vi.1959, *Mrs. A. V. Smith,* 1 ♂ (recorded by K. G. V. Smith,1959 : 168) ; *Hertford. (Rothamsted, Manor Wood), taken dead from nettles,* vi.1951, *B. R. Laurence* (1952 : 28), 1 ♂ ; *Somerset (Shapwick, Loxley Wood),* 7.vii.1951, *C. N. Colyer,* 1 ♂ ; *Hants. (New Forest),* 16.vi.1894, *F. C. Adams* (1894*a* : 255, 1894*b* : 249–50 and 1896 : 233, *correction*), 1 ♂ ; 9.vii.1896 (1896 : 233), *? sex ;* 25.vi.1897 (1897 : 280–81), 1 ♀ ; 28.vii *and* 13.viii.1908 (1908 : 208 *and* 237), 2 ♀ ; 18.vi.1903, *F. Jenkinson* (1903 : 227), 1 ♂ ; *Surrey (Ewhurst),* 3.vii.1936, *A. M. Low,* 1 ♀ ; *(Ashtead Woods),* 26.vi.1932, *R. L. Coe* (1932 : 204), 1 ♂ ; *Kent (Woolwich Wood, Woolage Green),* 7.viii.1955, 31.vii, 11.viii.1956, *E. A. Fonseca* (1957 : 15–16), 3 ♂ ; *(Bromley, Fisher's Wood),* 24.vi.1963, *P. J. Chandler,* 1 ♂

– Hind tibiae not broadened at tip and without an apical fringe of bristly hairs ; third antennal segment very small, brownish ; arista entirely black ; scutellum entirely yellow ; wing length 8·0–9·5 mm..... **scutellatus** Macquart (not known as British, exotic specimens examined)
Central and southern Europe





FIGS. 58–59.—*Nephrocerus flavicornis*. 58, male hypopygium. 59, female ovipositor.

Genus **Alloneura** Rondani

The seven British representatives of this genus are all small flies, their wing lengths varying from 2·0–4·25 mm. *A. littoralis*, as its name suggests, is a shore species, frequenting sand-dunes around our coasts, and the identity of the Homopteron (or Homoptera) that it parasitizes should not be too difficult to discover. *A. cilitarsis* has so far only been recorded from forested areas in the Scottish Highlands, while the remaining species are widely distributed and do not appear to be confined to any particular kind of habitat. The only breeding records of European *Alloneura* of which I am aware are of a female of a non-British species (that I have failed to identify beyond the

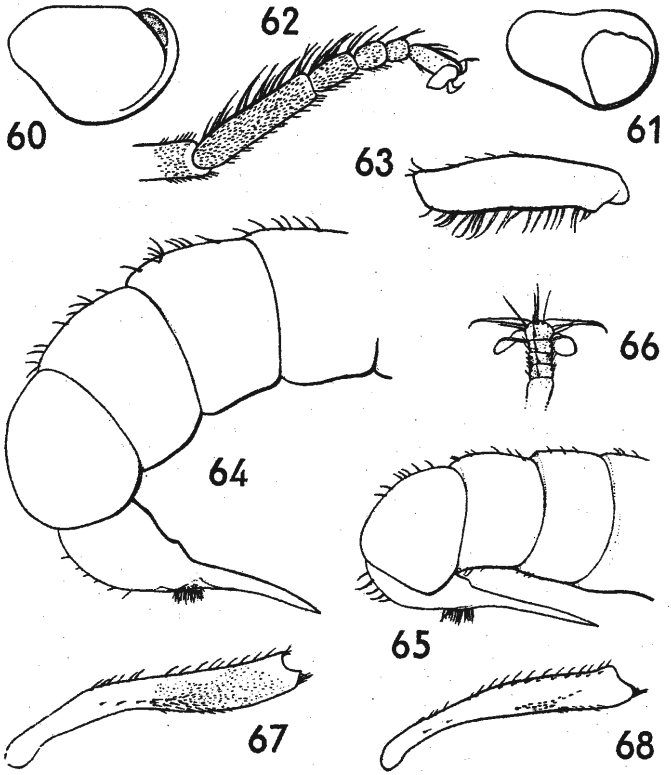
genus) bred from *Opsius* sp. (Cicadellidae) in Southern France by H. L. Parker, and of a female identified by me as *A. sylvatica* ; this latter example was bred from *Arthaldeus pascuellus* Fallén (Cicadellidae) in Germany by Doctors H. Strübling and H.-J. Müller. In Japan Koisumi (1959 : 37–45 and 1960 : 33–42) and others have bred several species of *Alloneura* from cicadellid pests in paddy-fields.

Collin (1920) keyed briefly the seven species now recognized as British, describing *flavitarsis* (now *palliditarsis*) as new to science.

KEY TO SPECIES

1 Humeri yellow, sometimes heavily grey-dusted.....2
– Humeri blackish ; tarsi yellow apart from last segment, which is blackish ; small species ; wing length 2–3·5 mm.

palliditarsis Collin (*flavitarsis* Collin, preocc.)
Inverness. (*Nethy Bridge*), *C. G. Lamb ; Cambridge.* (*Chippenham Fen*), *J. E. Collin ; Suffolk* (*Barton Mills*), *J. E. Collin ;* (*Tuddenham*), *C. Morley ; Hants.* (*Matley Bog*), *W. D. Hincks ;* (*Aldridge Hill*), *J. E. Collin ; Sussex* (*Crowborough*), *F. Jenkinson. vi–ix*



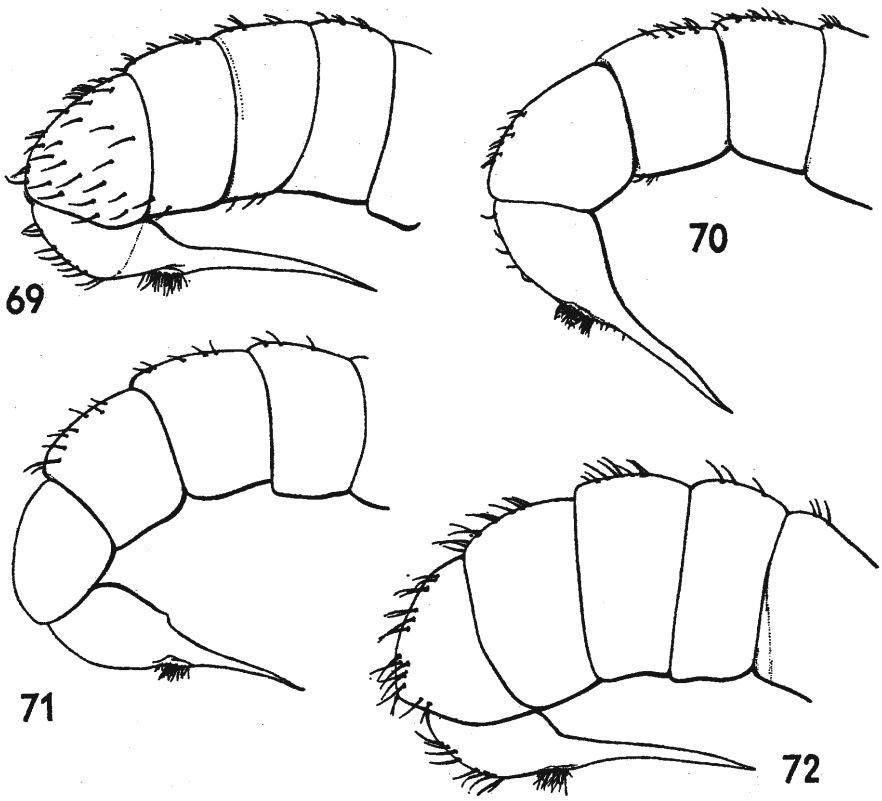
FIGS. 60–68.—60–61, *Alloneura* ♂, abdominal segment 8, showing membraneous area. 60, *littoralis* ; 61, *minima*. 62, *Alloneura cilitarsis* ♂, hind tarsus, showing posterodorsal ciliation. 63. *A. kuthyi* ♂, hind femur, showing posteroventral ciliation. 64–65, *Alloneura*, female ovipositor. 64, *littoralis* ; 65, *minima*. 96, *A. sylvatica* ♀, front tarsus, showing pulvilli and claws. 67–68, *Alloneura* ♀, hind tibiae, from behind. 67, *cilitarsis* ; 68, *sylvatica*.

2 Males 3
– Females 8
3 Thorax from front view whitish-grey dusted, at least anteriorly ; eyes touching on frons for only a very short distance 4
– Thorax from front view brownish or blackish, without a trace of whitish-grey dusting, any restricted anterior dusting being brownish-grey ; eyes touching for a fairly long distance on frons 5
4 Thorax entirely grey from front view ; tergites with pale hairs ; abdominal segment 8 small (fig. 60) with membraneous area very narrow, slit-like, occupying only a fractional part of right margin of segment ; hind trochanters with a few short dark spines ; all tarsi yellowish, except last segment sometimes more or less distinctly darkened ; wing length 3·25–4 mm..... **littoralis** Becker ♂
Coastal areas throughout British Isles. Widely distributed in the vicinity of sand dunes. v–ix
– Thorax greyish on anterior part only, otherwise dark brownish-grey; humeri and front of thorax with longer hairs than in *littoralis* ♂; tergites with dark hairs; segment 8 (fig. 61) with membraneous area roundish, occupying practically right half of segment ; hind trochanters with a few short pale hairs only ; all tarsi darkened ; normally smaller species ; wing length 2·75 mm. (only two examples examined) **minima** Becker ♂
Norfolk (*Waxham*), *F. W. Edwards;* (*Blakeney Point*), *J. E. Collin; Suffolk* (*Barton Mills*), *J. E. Collin;* (*Livermore*), *C. G. Nurse. vi–viii.*
5 Hind tarsi (fig. 62) with a posterodorsal ciliation of longish black hairs on at least the first two segments ; abdominal segment 8 is short, not half as long as tergite 5 ; pulvilli shorter than last tarsal segment ; wing length 3·5–4·25 mm. **cilitarsis** Strobl ♂
Moray. (*Logie*), *F. Jenkinson;* (*Brodie*), *J. W. Yerbury; Inverness.* (*Nethy Bridge & Glenmore*), *J. W. Yerbury; Aberdeen.* (*Balmoral Forest*), *R. L. Coe. vi–viii.*
– Hind tarsi without such ciliation 6
6 Viewed from behind, abdominal segment 8 has membraneous area very narrow, slit-like (as in *littoralis* ♂) ; segment 8 is at least half as long as tergite 5 ; wing length 3–4·25 mm..... **sylvatica** Meigen ♂
Generally distributed. v–ix.
– Viewed from behind, segment 8 has membraneous area circular, occupying at least right half of segment 7
7 Hind femora (fig. 63) with an outstanding posteroventral ciliation of delicate pale hairs ; abdominal segment 8 is fairly long, quite two-thirds as long as tergite 5 ; sternites without velvet-like pile ; wing length 2·75–4·0 mm. **kuthyi** Aczel (*geniculata* Collin nec Meigen) ♂
Generally distributed from Stafford. southwards. v–ix.
– Hind femora with shorter, less obvious, posteroventral ciliation ; abdominal segment 8 is short, at most one-third as long as tergite 5 ; sternites clothed with brown, velvet-like pile ; wing length 3·0–3·75 mm... **nigritula** Zetterstedt ♂
Lancs., then generally distributed from Stafford. southwards v–ix.
8 Tergites with pale hairs ; frons dusted greyish, often very lightly and patchily on upper part ; ocellar triangle shining black ; base of ovipositor (fig. 64) only weakly spherical, shorter than piercer (Wing length, distribution and dates, see ♂)..... **littoralis** Becker ♀
– Tergites with dark hairs 9
9 Frons entirely dull, dusted greyish, even if only thinly on upper part..... 10
– Frons brightly shining to a greater or less extent in front of ocellar triangle..... 11
10 Ovipositor (fig. 69) with piercer quite strongly curved, very long, reaching to tip of sternite 1 ; frons only sparingly dusted on upper part ; claws strikingly long ; pulvilli longer than last tarsal segment and very wide. (Wing length, distribution and dates, see ♂)..... **kuthyi** Aczel (*geniculata* Collin nec Meigen) ♀
— Ovipositor (fig. 65) with piercer absolutely straight, moderately long, reaching slightly beyond tip of sternite 3 ; frons evenly dusted ; claws and pulvilli only moderately long. (Wing length, distribution and dates, see ♂) **minima** Becker ♀
11 Front and mid femora soon after base with a ventral pair of short stoutish spines placed closely side by side, the anterior one the shorter ; hind trochanters ventrally with two or more such spines ; claws noticeably large..... 12

— Such spines absent ; claws short, pulvilli at most subequal in length to last tarsal segment ; hind tibiae only slightly curved at base, apical half straight ; ovipositor (fig. 70) with piercer practically straight, considerably longer than base. (Wing length, distribution and dates, see ♂).....**nigritula** Zetterstedt ♀

12 Hind tibiae (fig. 67) abruptly bent down shortly after middle ; hind trochanters (in the two examples examined) with two short stoutish spines ventrally ; pulvilli subequal in length to last tarsal segment ; ovipositor (fig. 71) with piercer straight, longer than base. (Wing length, distribution and dates, see ♂) **cilitarsis** Strobl ♀

— Hind tibiae (fig. 68) very slightly and evenly downcurved ; hind trochanters (in numerous specimens examined) with 3–6 short stoutish spines ventrally ; pulvilli (fig. 66) noticeably large, much longer than last tarsal segment ; ovipositor (fig. 72) with piercer almost straight, much longer than base. (Wing length, distribution and dates, see ♂).....**sylvatica** Meigen ♀



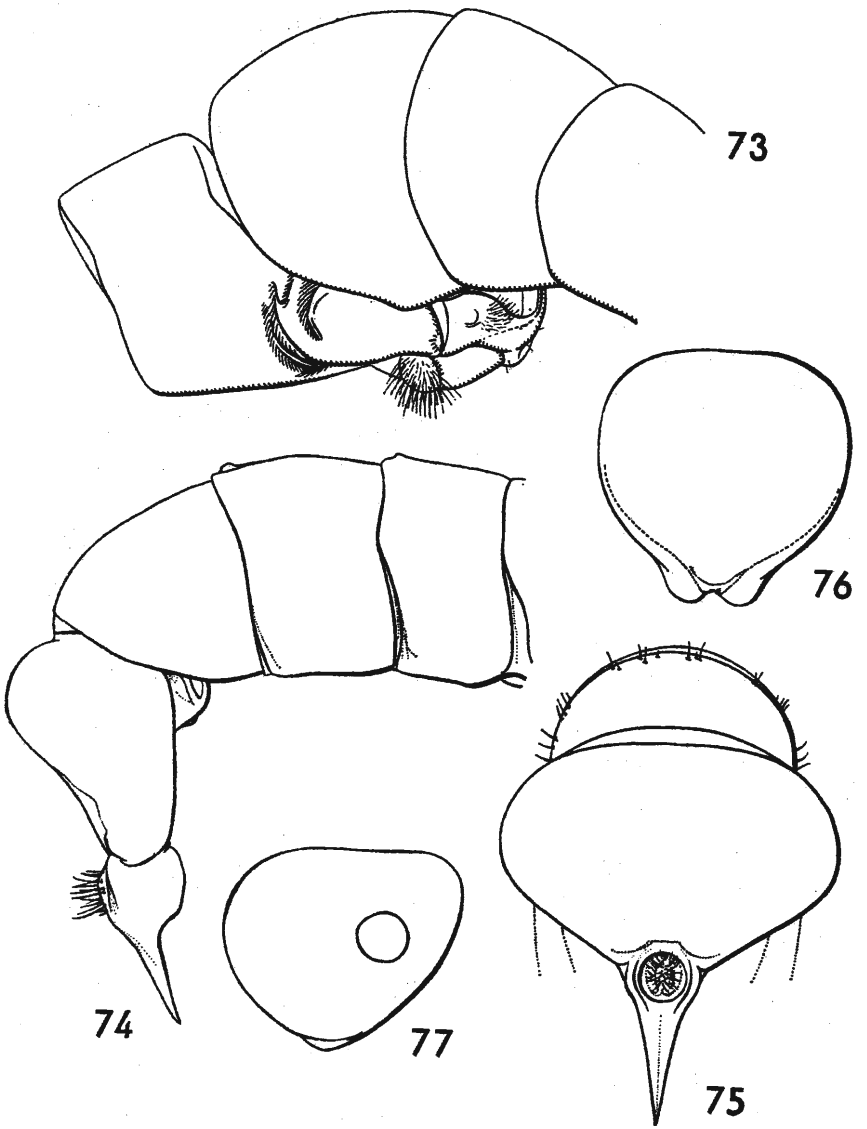
FIGS. 69–72.—*Alloneura*, female ovipositor. 69, *kuthyi* ; 70, *nigritula* ; 71, *cilitarsis* ; 72, *sylvatica*.

Genus **Dorylomorpha** Aczel

The British representatives of this genus are medium to large-sized species, their wing length varying from 3·25 to 5·75 mm. They are shining black, a few having yellowish abdominal markings. Included is *haemorrhoidalis*, probably the most easily recognized of British Pipunculidae because of the strikingly large genitalia in both sexes. The habitats are varied. In Den-

mark Lundbeck (1922 : 53) found *maculata* in some numbers in a small wood swarming low over Bilberry (*Vaccinium myrtillus*), and I have taken a series of the same species under similar conditions in the Scottish Highlands.

I can find no host records, the only instances of breeding of which I am aware being the following from the pupal stage: *D. imparata*, 1 ♀, Berks.



FIGS. 73–77.—73, *Dorylomorpha haemorrhoidalis*, male hypopygium, from side. 74–75, *D. haemorrhoidalis*, female ovipositor. 74, from side. 75, from behind. 76–77, *Dorylomorpha* ♂, abdominal segment 8, from behind. 76, *confusa*; 77, *xanthopus*.

(Wytham), em. 18.v, from pupa in soil under oak, G. C. Varley ; *D. xanthocera* (not recorded as British), 1 ♂, Bohemia (Mies), pupa fixed to twig of a *Ribes* shrub, 7.iv, adult emerged 27.iv, J. Ott (1900 : 25) ; *D. haemorrhoidalis*, Denmark, pupae found on 9.ii and 13.iv in flood refuse, adults emerged on 10.v and 2.vi respectively, W. Lundbeck (1922 : 49).

Collin (1937) keyed ten British species, describing *infirmata*, *imparata* and *extricata* as new to science. In the present key I add *clavifemora* sp. n., thus bringing our total of *Dorylomorpha* to eleven.

KEY TO SPECIES

1 Humeri yellowish ; hind tibiae with a distinct yellow bristle at middle anteriorly (occasionally two such bristles) ; at least front femora usually with at least a trace of a brownish or blackish dorsal spot soon after base ; legs otherwise yellow ; wing length 4–5 mm. ♂ frons at narrowest part linear, less wide than front ocellus ; tergites 2–4 often have lateral yellowish markings posteriorly, those on tergite 3 usually being more extensive ; abdominal segment 8 with a rather narrowly oval, medium sized membraneous area, not nearly occupying right half of segment. ♀ frons smooth, shining on upper part only ; at least tergites 3 and 4 with broad yellow side-margins ; ovipositor quite small, base moderately deep, strongly convex below, concave above, where at tip there is a large yellow protuberance ; piercer about as long as base, practically straight.
maculata Walker
Inverness., Aberdeen., and northwards, then Dumfries., Norfolk, Worcester., Cambridge., Suffolk., Oxford., Hereford., Kent, Sussex. vii–x.

– Humeri darkened ; hind tibiae without a distinct yellow bristle at middle anteriorly (except in *beckeri*) 2

2 Legs with only knees distinctly yellow ; humeri, area of thorax between humeri, and scutellum with much longer hairs than usual ; wing length 4 mm. (four examples examined). ♂ abdominal segment 8 with membraneous area roughly oval, rather deep, extending full depth of segment. ♀ ovipositor with piercer very short, at most not longer than basal part.
beckeri Aczel (*incognita* Verrall 1911 ♂♀, nec 1901 ♀)
Moray. (*Brodie*), *Nairn.* (*Nairn*), *J. W. Yerbury; Inverness.* (*Aviemore*), *C. G. Lamb. v–vi.*

– Legs more extensively yellowish ; humeri, area of thorax between humeri, and scutellum with the usual very short and inconspicuous pubescence 3

3 Hypopygium in both sexes strikingly larger than usual ; femora black, broadly yellow-tipped ; wing length 4–5 mm. ♂ abdominal segment 8 (fig. 73) with membraneous area large, oval, occupying entire depth of segment ; hypopygium reaching back almost to level of tip of segment 3 (or even beyond, dependent on curvature of abdomen). ♀ ovipositor (figs. 74, 75) with basal part at least as wide as base of tergite 6, remarkably swollen, usually yellow, occasionally more or less darkened ; piercer shorter than base, bulbous, then rapidly tapering, reaching back beyond level of tip of tergite 3 and sometimes as far as base of this tergite ..... **haemorrhoidalis** Zetterstedt
Cheshire, Norfolk, Warwick., Cambridge., Suffolk, Hereford., Gloucester., Oxford., Buckingham., Berks., Middlesex, Hants., Surrey, Kent, Dorset. iv–viii.

– Hypopygium in both sexes not strikingly larger than usual. ♂ abdominal segment 8 with membraneous area either absent or small, except in *semimaculata* ♂, which has legs almost entirely yellow ; hypopygium only reaching back slightly beyond level of tip of tergite 4. ♀ ovipositor with base less wide than base of tergite 6, and the piercer rarely reaching back beyond level of tip of tergite 3; in *clavifemora* ♀ the yellow base of ovipositor is more swollen than usual, but is not longer than piercer 4

4 Males 5

– Females 12

5 Abdominal segment 8 without a membraneous area apically 6

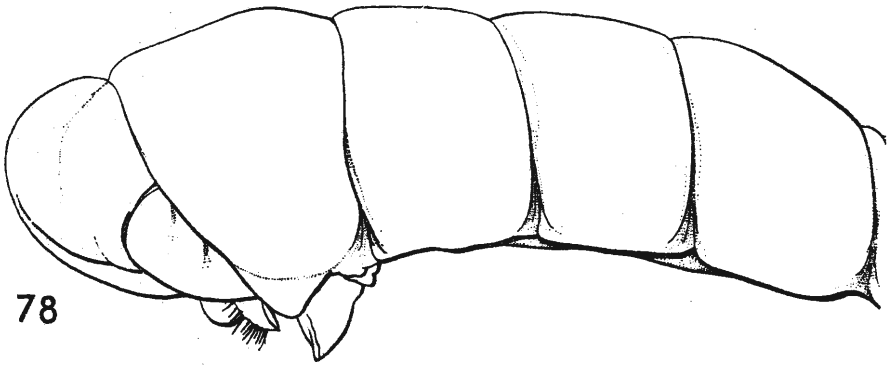
– Segment 8 with a membraneous area apically 9

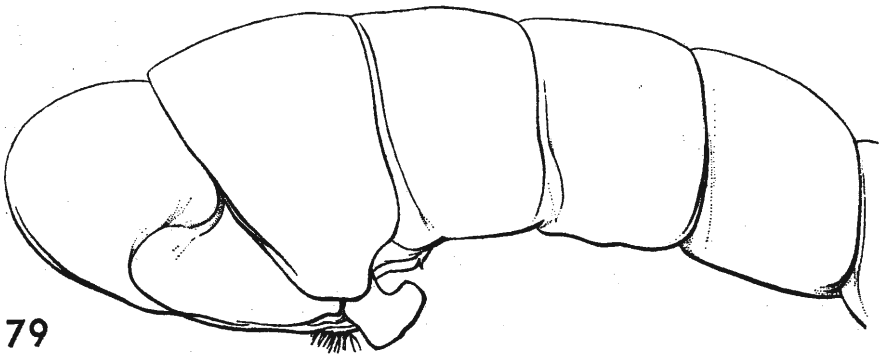
6 Hypopygium (figs. 76, 78) with exceptionally large projecting yellowish-orange roughly triangular lamellae, visible portion of anterior part (in *situ*) over twice as long as discal cross-vein (*r–m*) ; distance from anterior part of lamellae to tip

of abdomen not longer than tergites 1–3 together (measured on disc) ; femora black, rather broadly yellow-tipped ; tibiae and tarsi yellow, or with some dark markings ; wing length 4–5 mm.....**confusa** Verrall ♂
Generally distributed. iv–viii.

– Hypopygium with quite small lamellae, visible portion of anterior part (in situ) less than twice as long as discal cross-vein (*r–m*).....7

7 Hypopygium (fig. 79) large, distance from the anterior part of the projecting subtriangular lamellae to tip of abdomen *obviously* greater than length of tergites 1–3 together (measured on disc); legs coloured as in *confusa* ♂ ; wing length 4·75–5·25 mm.....**rufipes** Meigen ♂
Hereford., Oxford., Hertford., Wilts., Middlesex, Hants., Surrey, Sussex, Devon. v–vii.





FIGS, 78–79.—*Dorylomorpha*, male hypopygium, from side. 78, *confusa* ; 79, *rufipes*.

– Hypopygium (figs. 80, 81) smaller ; distance from the anterior part of the projecting lamellae to tip of abdomen not greater than length of tergites 1–3 together (measured on disc).....8

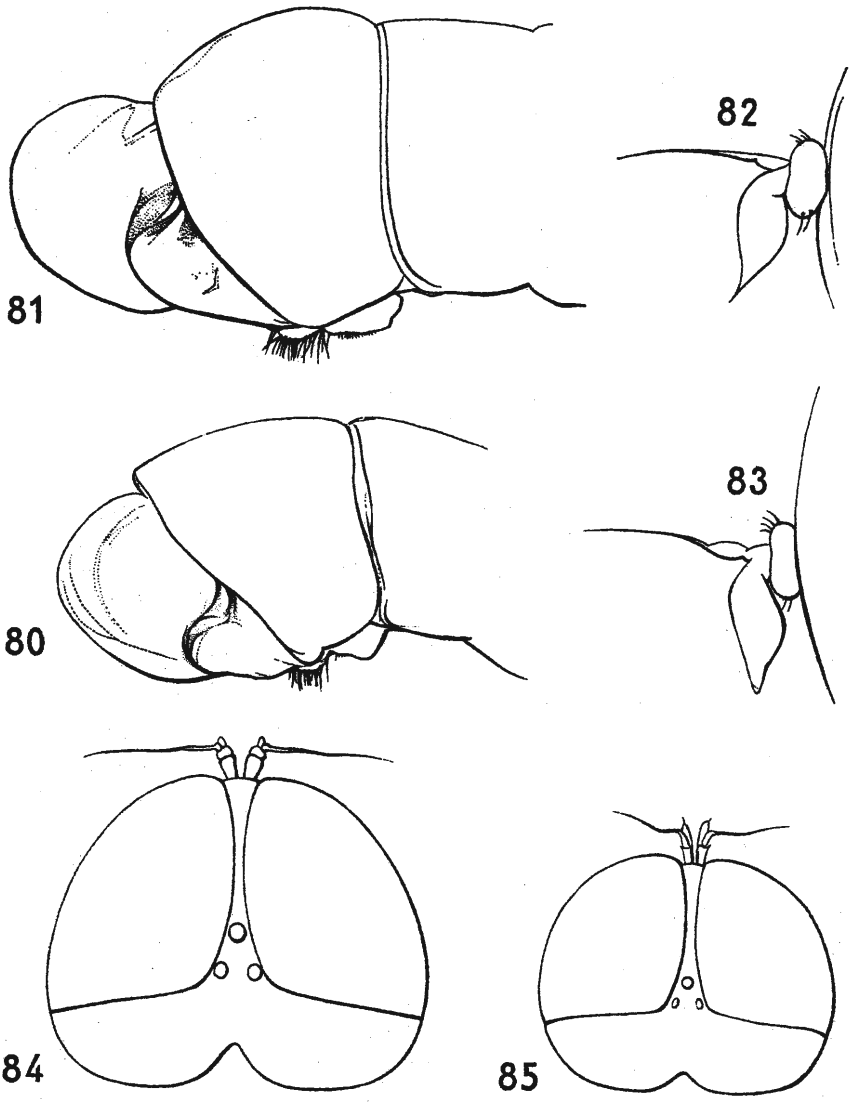
8 All trochanters and base of at least hind femora clear yellow ; hypopygium (fig. 80) ; wing length 4–5·5 mm.....**imparata** Collin ♂
Westmorland, Norfolk, Cambridge., Hereford., Gloucester., Oxford., Hertford., Berks., Somerset, Hants, Kent, S. Devon. iv–vi.

– All trochanters dark and femora darkened to actual base, except occasionally vaguely pale along ventral surface ; hypopygium (fig. 81) larger than in *imparata* ♂ ; wing length 5·25–5·75 mm.....**extricata** Collin ♂
Ross., Inverness., Dumbarton., Durham, Isle of Man, Cambridge., Hereford., Oxford., Wilts., Berks., Somerset, Cornwall. v–vi.

9 Trochanters yellow ; femora mainly yellow ; tibiae usually completely yellow, occasionally vaguely darkened below on apical half ; tarsi yellow apart from last segment vaguely darkened.....10

– Trochanters more or less darkened ; femora mainly blackish ; tibiae with more than apical half blackish ; body entirely black.....11

10 Frons at narrowest point linear, less wide than front ocellus ; tergites 3 and 4 with more or less distinct yellowish markings at sides ; legs entirely yellow apart from



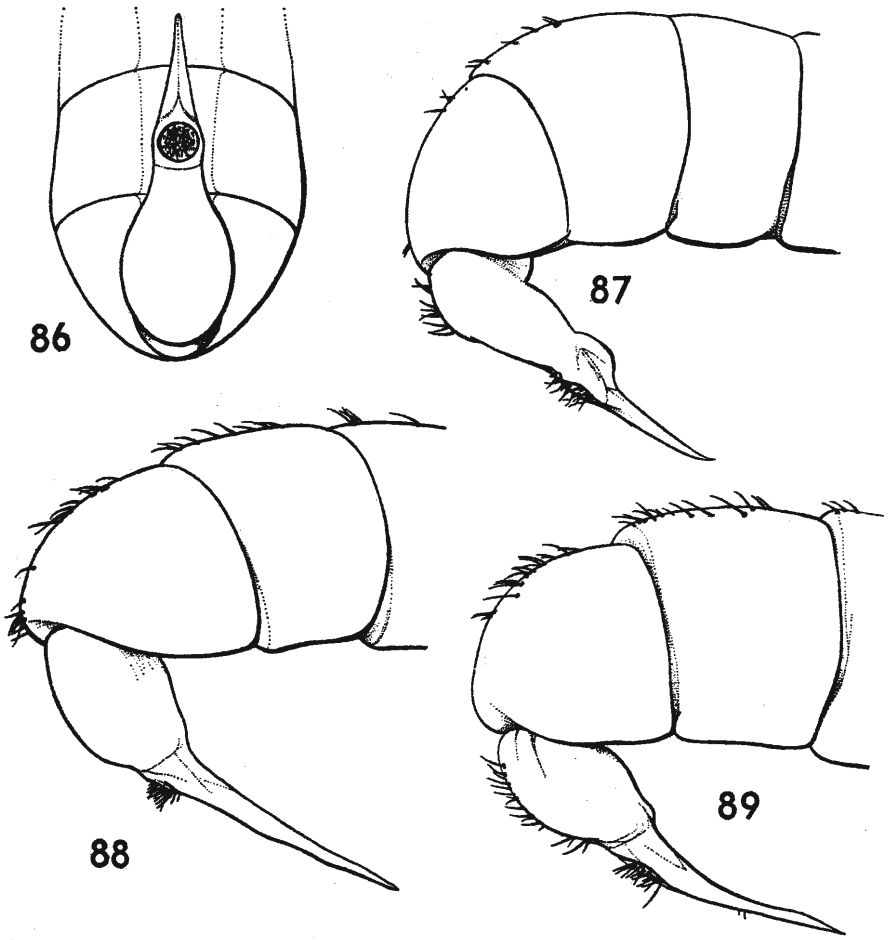
FIGS. 80–85.—80–81, *Dorylomorpha*, male hypopygium, from side. 80, *imparata* ; 81, *extricata*. 82–83, *Dorylomorpha* ♂, antenna and arista, from side. 82, *semimaculata* ; 83, *xanthopus*. 84–85, *Dorylomorpha*, male frons, from above. 84, *clavifemora* ; 85, *infirmata*.

a faint brownish ring at middle of hind femora and the usual vague darkening of last tarsal segment ; third antennal segment (fig. 82) shortly pointed ; hypopygium rather large ; segment 8 with membraneous area rather large ; wing length 4·5–5 mm.....**semimaculata** Becker ♂

Yorks., Worcester., Cambridge., Suffolk, Hereford., Oxford., Essex, Somerset, Kent. v–viii.

— Frons narrow, but less linear than in *semimaculata* ♂, quite as wide at narrowest point as front ocellus ; tergites normally all dark, but occasionally tergites 3 and 4 have more or less distinct yellow markings at sides ; femora with a more or less extensive dark area reaching along upper side from base, this darkening sometimes vague and restricted to middle ; tibiae usually completely yellow, sometimes vaguely dark below on apical half ; third antennal segment (fig. 83) blunt ; hypopygium smaller than in *semimaculata* ♂ ; abdominal segment 8 (fig. 77) with membraneous area small ; wing length 3·25–4·25 mm...**xanthopus** Thomson ♂

Generally distributed, but no records in extreme south-west. v–vii.



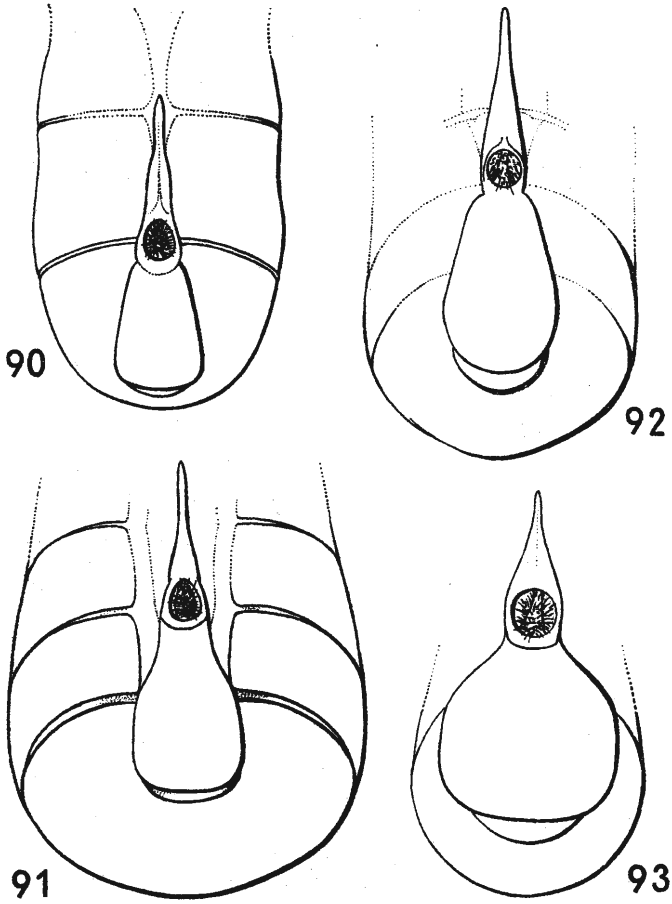
FIGS. 86–89.—*Dorylomorpha*, female ovipositor (86, from below ; 87–89, from side). 86, *semimaculata*. 87–89 87, *xanthopus* ; 88, *rufipes* ; 89, *confusa*.

11 Frons (fig. 84) at narrowest point linear, less wide than front ocellus ; hind femora abruptly and conspicuously clubbed for about apical two-thirds ; all femora narrowly yellow at base and broadly so at tip ; hypopygium and its visible appendages noticeably large ; wing length 5 mm. (two examples examined) **clavifemora** sp. n. ♂

Holotype ♂ : *Cambridge. (Chippenham Fen)*, 1.vii.1951, *L. Parmenter.* Paratype ♀ : *same locality and date as holotype, J. E. Collin.* Other material : same locality as holotype, 5.vii.1953, *E. A. Fonseca,* 1 ♀ *and* 27.vi.1965, *L. Parmenter,* 1 ♂, 1 ♀.

— Frons (fig. 85) narrow, but less linear than in *clavifemora* ♂, quite as wide at narrowest point as front ocellus ; hind femora gradually and only moderately thickened for about apical two-thirds ; femora black to base, only more or less broadly yellow-tipped ; hypopygium and its visible appendages quite small ; wing length 4·0–4·25 mm..... **infirmata** Collin ♂

Durham (Shotton Bog), Trechman; W. Yorks., (Askham Bog), W. D. Hincks; Cambridge. (Wicken Fen), C. G. Lamb; Suffolk (Barton Mills and Chippenham Fen), J. E. Collin; Huntingdon. (Wood Walton), F. W. Edwards; Oxford. (Bayswater), A. H. Hamm; Middlesex (Edgware), C. H. Andrewes; Ireland, Co. Cavan (Ballyconnell) R. L. Coe. v–vi.



FIGS. 90–93.—*Dorylomorpha,* female ovipositor, from below. 90, *imparata* ; 91, *extricata* ; 92, *xanthopus* ; 93, *clavifemora.*

12 Tergites 3 and 4 with broad yellow side-margins, which coloration extends more narrowly along sides of tergites 5 and 6, and sometimes along 2, and even 1; frons with a central ridge ; hind tibiae without a distinct yellow bristle at middle anteriorly ; ovipositor (fig. 86) yellow or orange, base rather broadly oval, flattened below with a more or less broad depression ; piercer about as long as base, broad, then tapering and upcurved to the pointed tip. (Wing length, distribution and dates, see ♂).....**semimaculata** Becker ♀

— No distinct yellow side-margins to tergites, except occasionally in *xanthopus* ♀, which may have restricted yellow markings at sides of tergites 3 and 4 (but is distinguishable by other key characters from *semimaculata* ♀).....13

13 Ovipositor all yellowish.....14

— Ovipositor with at least basal part darkened.....16

14 Viewed from behind, the base of ovipositor (fig. 93) is nearly as wide as base of tergite 6 ; piercer slightly longer than base, tapering throughout. (Wing length, distribution and dates, see ♂).....**clavifemora** sp. n. ♀

— Viewed from behind, the base of ovipositor is scarcely one-third as wide as base of tergite 6.....15

15 Femora only darkened at base above ; tibiae entirely yellow ; ovipositor (figs. 87, 92) with piercer bulbous at base, without flanges, rather long, steadily tapering to a point, reaching back beyond tip of tergite 3. (Wing length, distribution and dates, see ♂).....**xanthopus** Thomson ♀

— Femora more extensively darkened ; tibiae at least somewhat darkened on apical half ; ovipositor (fig. 94) with piercer broadened towards base by two flanges, and shorter than in *xanthopus* ♀, only reaching back to about middle of tergite 4. (Wing length, distribution and dates, see ♂).....**infirmata** Collin ♀

16 Ovipositor (figs. 88, 89) with piercer in profile not very stout at base, gradually tapering to tip, much longer than basal part.....17

— Ovipositor (figs. 90, 91) with piercer in profile stout at base, rapidly tapering, leaving the end half slender, very little longer than basal part.....18

17 Piercer (fig. 88) long and straight. (Wing length, distribution and dates, see ♂) **rufipes** Meigen ♀

— Piercer (fig. 89) slightly shorter and upcurved. (Wing length, distribution and dates, see ♂).....**confusa** Verrall ♀

18 Trochanters obscured ; ovipositor (fig. 91) with base suddenly constricted towards tip (best viewed from beneath). (Wing length, distribution and dates, see ♂) **extricata** Collin ♀

— Trochanters clear yellow ; base of ovipositor (fig. 90) with practically no constriction. (Wing length, distribution and dates, see ♂).....**imparata** Collin ♀

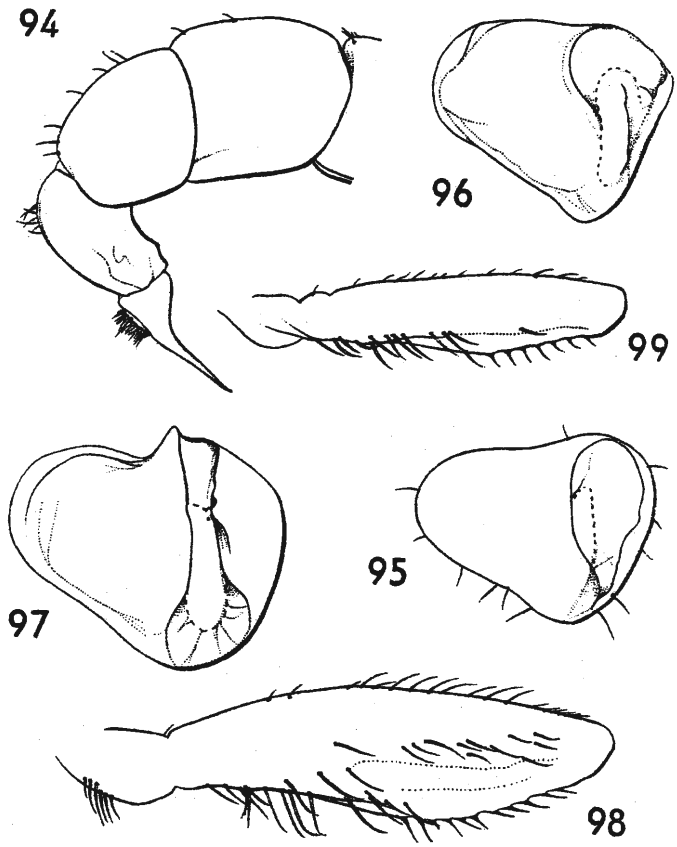
Genus **Pipunculus** Latreille

The British species of *Pipunculus* are blackish, more or less shining, of medium to large size, their wing length varying from 5–8 mm. (apart from *spinipes*, which has exceptionally long wings, the maximum is 6·5 mm.). Included in the genus are *campestris* and *thomsoni*, two of the commonest and most widely distributed Pipunculidae in Britain. These two species often occur with *Verrallia aucta* among brambles edging woodlands on dry sunny days in summer. Several other European species bear a strong superficial resemblance to *campestris* and *thomsoni*, and in consequence misidentifications of material of this genus both in Britain and on the Continent have probably been even more numerous than in other groups of Pipunculidae.

Records of the breeding habits of *Pipunculus* are very few. In the three instances where I have identified bred adults the material has all proved to be *campestris*, and the host Homoptera to belong to the Cicadellidae (Jassidae). Details of these records are as follows: *P. campestris*, Germany, series ♂♂, ♀♀ bred from *Macrosteles laevis* Ribaut (Cicadellidae), emerged vii, viii and x, H. Strübling and H.-J. Müller ; 1 ♀ bred from *Arthaldeus pascuellus* Fallén (Cicadellidae), emerged iv, same collectors ; 1 ♀ bred from *Cicadula quadrinotata* Fabricius (Cicadellidae), emerged iv, same collectors. In addition,

Mik (1882 : 216, footnote 2) records a *Pipunculus* species bred from a larva in the abdomen of *Grypotes puncticollis* Herrich-Schaeffer (Cicadellidae). but it cannot be ascertained whether Mik's specimen belonged to *Pipunculus* in the present restricted sense.

In the following key I describe two species, *phaeton* and *fonsecai*, as new to science, bringing the total of our British *Pipunculus* to seven.



FIGS. 94–99.—94. *Dorylomorpha infirmata*, female ovipositor, from side. 95–97, *Pipunculus* ♂, abdominal segment 8, showing membraneous area. 95, *zugmayeriae*; 96, *phaeton*; 97, *varipes*. 98–99, *Pipunculus* ♂, hind femora, externodorsal view. 98, *thomsoni*; 99, *fonsecai*.

KEY TO SPECIES

1 Males 2
– Females 8
2 Stigma (fig. 100) long, subequal in length to, or longer than, the next costal segment of wing 3
– Stigma (fig. 101) very short, much shorter than the next costal segment; tergites 2–5 with conspicuous greyish side-margins; viewed from behind, tergites 2–5 are moderately shining black, but not glittering; hind femora not becoming abruptly stout and deep on apical half; eyes touching for not more than length

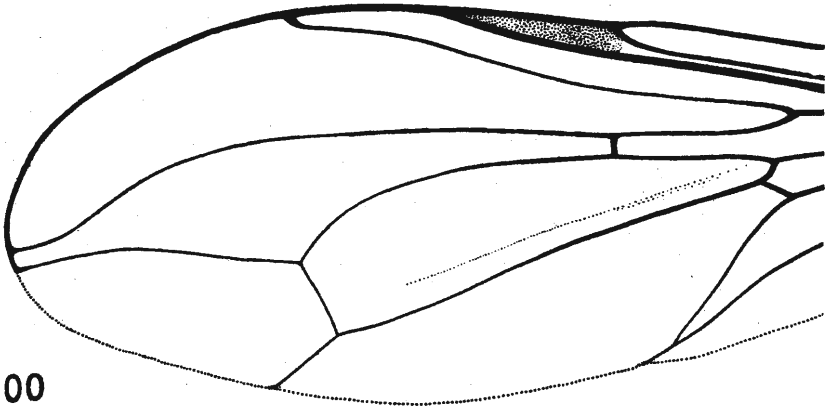
of frons ; thorax with brownish dusting rather dense on disc, so that the shining black ground colour is more or less obscured ; last section of M_{1+2} considerably undulating ; wings not noticeably long in proportion to body ; halteres with blackish knob ; abdominal segment 8 (fig. 95) with membraneous area rather narrow, widening out more or less towards upper extremity ; small or medium-sized species ; wing length 5–6 mm. ..... **zugmayeriae** Kowarz ♂

Suffolk (*Barton Mills*), *J. E. Collin* ; (*Woodbridge, Parham*), *C. Morley* ; *Gloucester.* (*Filton, nr. Bristol*), *E. A. Fonseca* ; *Oxford.* (*Bagley Wood*), *A. H. Hamm* ; *Buckingham.* (*Langley Park*), *O. W. Richards* ; *Surrey* (*Beddington*), *L. Parmenter* ; (*Ashstead and New Malden*), *R. L. Coe. v–vii.*

3 Viewed obliquely from in front, tergite 2 is partly or entirely obscured with transverse streaks of brownish dusting 4

– Viewed obliquely from in front, tergite 2 is entirely glittering black, without any trace of brownish dusting ; thorax, scutellum and other tergites extensively glittering black ; abdominal segment 8 (fig. 96) with membraneous area rounded above, more or less narrowing below ; all femora completely polished behind, black except at tip, and sometimes at extreme base; hind femora anteroventrally hollowed on about basal half, so that the thickening of apical part is more abrupt ; tibiae darkened for more than apical half ; tarsi darkened, at least dorsally ; wing length 5–6 mm. ..... **phaeton** sp. n. ♂

Holotype ♂ : *Oxford.* (*Oxford*), 27.vi.1909, *J. R. Malloch.* Paratypes : *Cheshire* (*Rostherne*), *no date stated*, *H. Britten*, 1 ♀ ; *Glamorgan.* (*Port Talbot*), 24.viii.1908, *J. W. Yerbury*, 1 ♂ ; *Somerset* (*Sharpham*), 22.viii.1922, *H. Audcent*, 1 ♀ ; *Hants.* (*Woolmer Forest*), 12.vii.1903, *J. W. Yerbury*, 1 ♀ ; (*New Forest, Ridley Wood*), 9.ix.1947, *C. N. Colyer*, 1 ♀ ; *Devon.* (*Haytor, Dartmoor*),



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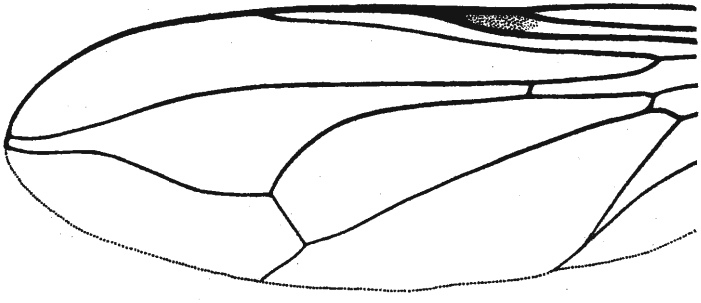
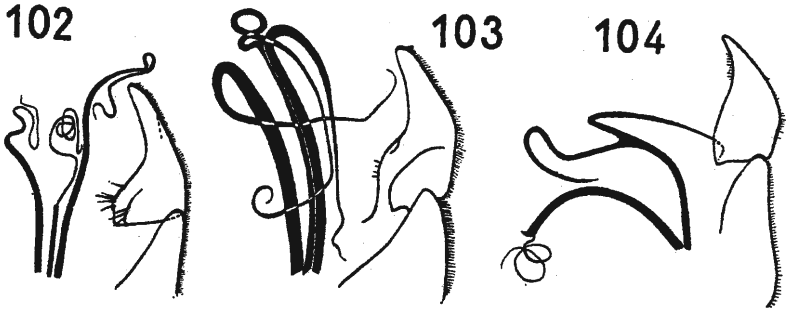


101

FIGS. 100–101.—*Pipunculus*, wing. 100, *spinipes* ; 101, *zugmayeriae.*

22.vi.1960, *J. R. Vockeroth*, 1 ♂ ; *Dorset* (*Lamworthy*), 12.viii.1894, *J. W. Yerbury*, 1 ♂. Other Material : *Oxford.* (*Oxford and Hogley*), v–viii.1909, *A. H. Hamm*, 1 ♂, 1 ♀ ; *Dorset* (*Corfe*), 5.vi.1960, *C. H. Andrewes*, 1 ♀. *v–ix.*

4 Abdominal segment 8 with membraneous area roundish or narrowly oval on at least upper part ; viewed obliquely from in front, thorax is usually extensively obscured by brownish dust, with ground colour not glittering where exposed....5



FIGS. 102–104.—*Pipunculus*, male hypopygium (part). 102, *campestris* ; 103, *thomsoni* ; 104, *fonsecai*.

Abdominal segment 8 (fig. 97) with membraneous area mainly narrow, only broadening below ; body mainly glittering black ; tergites 1–5 glittering black sublaterally, with at most a vague narrow edging of whitish-brown dusting ; frons long and quite narrow, with eyes normally in contact for not more than length of frons ; third antennal segment blackish-brown, short and blunt ; four anterior femora polished behind from base to tip for at least almost lower half ; trochanters yellow ; femora broadly yellow-tipped and more narrowly yellow at base ; tibiae yellow except for a rather vague darkening at middle ; tarsi yellow except for the darkened last segment (occasionally more extensively darkened) ; wing length 5·75–6·5 mm.....**varipes** Meigen ♂

Moray., Dumbarton., Westmorland, Cambridge., Norfolk, Suffolk, Hereford., Glamorgan., Wilts., Berks., Somerset., Surrey, Devon. W. Ireland (*Co. Clare, The Burren*). *vi–viii, x*

5 Tergites 2–5 with conspicuous greyish side-markings, at least when viewed from behind 6

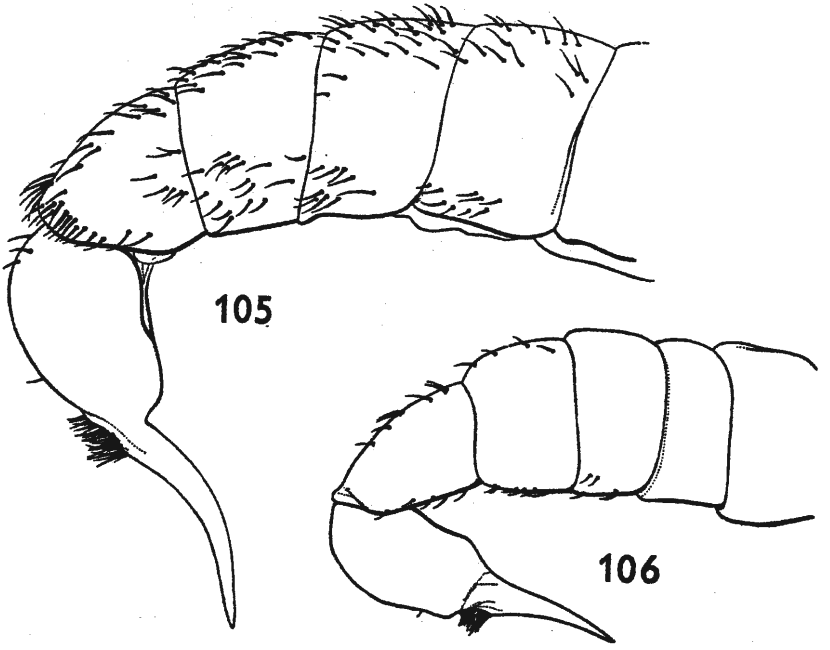
- Tergites 2–5 at sides with inconspicuous brownish-grey dusting only ; scutellum on apical half (normally) practically undusted, brightly shining ; viewed from above, or obliquely from in front, tergites 2–4 are entirely obscured on disc with dense brownish dusting, or occasionally more or less shining along posterior margins ; hind femora anteroventrally hollowed on basal part, thickest shortly after middle ; leg coloration as in *phaeton* ♂ ; abdominal segment 8 with membraneous area resembling that of *phaeton* ♂ (see fig. 96) ; stigma longish, about one and a half times as long as next costal segment ; hypopygium (fig. 102) ; wing length 4·5–6·25 mm.....**campestris** Latreille ♂

Generally distributed. iv–x.

6 Viewed from above, tergites 2–5 with any visible transverse streaks of brownish or brownish-grey dusting narrow, and when present on tergite 2 not nearly reaching back to posterior margin ; viewed from behind, tergites 2–5 are moderately shining black, but not glittering ; conspicuously light grey sublaterally, this colour extending upwards as linear posterior stripes for a brief distance on to dorsum ; eyes touching for much more than length of frons ; thorax with brown dusting thin or absent on at least middle of disc, where the shining black ground colour is visible ; four anterior femora dull grey behind except for a narrow posteroventral shining strip ; legs otherwise black, apart from femora narrowly yellow-tipped, and tibiae yellow for less than basal half and at extreme tip ; wings (fig. 100) noticeably long in proportion to body, with last section of M_{1+2} only slightly undulating ; halteres yellowish ; large species ; wing length 6·5–8 mm.

spinipes Meigen ♂

Worcester. (*Wyre Forest*), *C. J. Wainwright ; Suffolk* (*Barton Mills*), *J. E. Collin ; Hereford.* (*Doward and Haugh Wood*), *J. H. Wood; Gloucester.* (*Tickenham*), *H. Audcent; Buckingham.* (*Langley Park*), *O. W. Richards; Berks.* (*Boars Hill*), *M. Ackland: Hants.* (*New Forest*), *F. C. Adams; Devon.* (*Haytor, Dartmoor*), *J. R. Vockeroth; Sussex* (*Alfriston*), *G. E. Shewell. vi–vii.*



FIGS. 105–106.—*Pipunculus*, female ovipositor. 105, *varipes* ; 106, *fonsecai.*

– Viewed from above, tergites 2–5 exhibit conspicuous dense transverse streaks of brownish or brownish-grey dusting, occupying practically the entire disc of tergite 2 except perhaps the posterior corners, and becoming narrower on succeeding tergites, so that the glittering black ground colour is increasingly exposed . . 7

7 Hind femora (fig. 98) deeply hollowed anteroventrally on basal part, becoming abruptly and strikingly deep on more than apical half ; scutellum completely, even if only lightly, yellow-dusted (the shining black ground colour often visible through rubbing) ; abdomen not noticeably narrow ; legs quite extensively yellow ; claws and pulvilli noticeably large ; hypopygium (fig. 103) ; normally large species ; wing length 4–6 mm.

thomsoni Becker (*pratorum* Verrall *et alia*, nec Fallén) ♂

Generally distributed. vi–ix.

– Hind femora (fig. 99) only slightly hollowed anteroventrally on basal part, gradually and moderately thickening from base until shortly before tip ; scutellum obviously and evenly brown-dusted on basal part, glittering black apically with at most scattered dusting ; abdomen noticeably narrow ; legs with pale markings obscure, apart from broadly yellow knees ; claws and pulvilli quite small ; hypopygium (fig. 104) ; small species ; wing length 4 mm. (not appreciably varying in fourteen specimens examined) . . . . . **fonsecai** sp. n. ♂

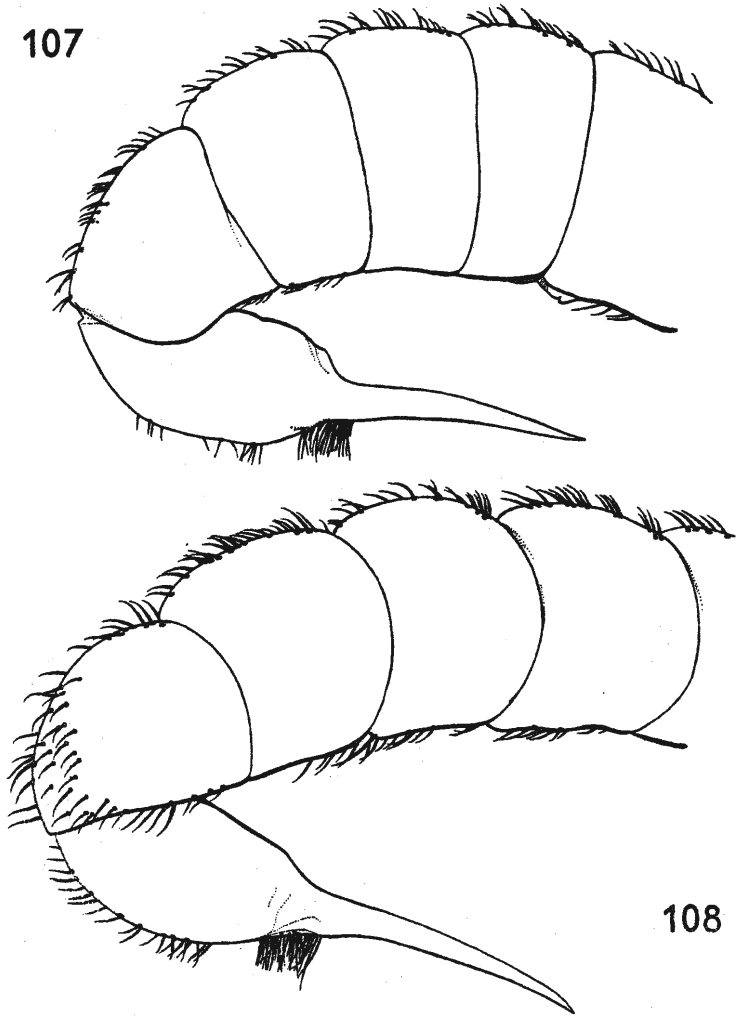
Holotype ♂ : *Norfolk* (*Kilverstone*), 7 vii 1953, *E. A. Fonseca.* Paratypes : *Inverness* (*Abernethy*), 23 vi 1959, *C. H. Andrewes*, 1 ♂ ; same data as holotype, 4 ♂ 4 ♀ ; *Kent* (*Sevenoaks*), 4 vii 1965, *L. Parmenter*, 1 ♀ ; *Sussex* (*Crowborough*), 27–30.vi.1904, *F. Jenkinson*, 3 ♀.

8 All femora polished behind from base to tip along at least almost lower half ; frons shining and undusted (or with only thin dusting so that the shining black

ground colour is not entirely obscured) on at least upper part ; all trochanters clear yellow ; all femora narrowly yellow at tip, often more or less obscurely so at base ; all tibiae extensively yellow or yellowish-orange, usually with more or less vague brownish markings on more than apical half ; all tarsi usually mainly yellow or yellowish-orange with last segment or two darkened, but darkening sometimes more extensive 9

– Front and mid femora quite dull behind except for at most a narrow posteroventral strip 10

9 Thorax on disc with grey or brownish-grey dusting extending back from anterior margin to a point only slightly beyond humeri, otherwise with shining black ground colour absolutely unobscured ; ovipositor (fig. 109) with base rather shallow, somewhat flattened below, distinctly shorter than piercer, which is moderately downcurved ; femora with posterior dusting sparser than in *campestris* ♀. (Wing length, distribution and dates, see ♂)..**phaeton** sp. n. ♀



FIGS. 107–108.—*Pipunculus*, female ovipositor. 107, *thomsoni* ; 108, *spinipes*.

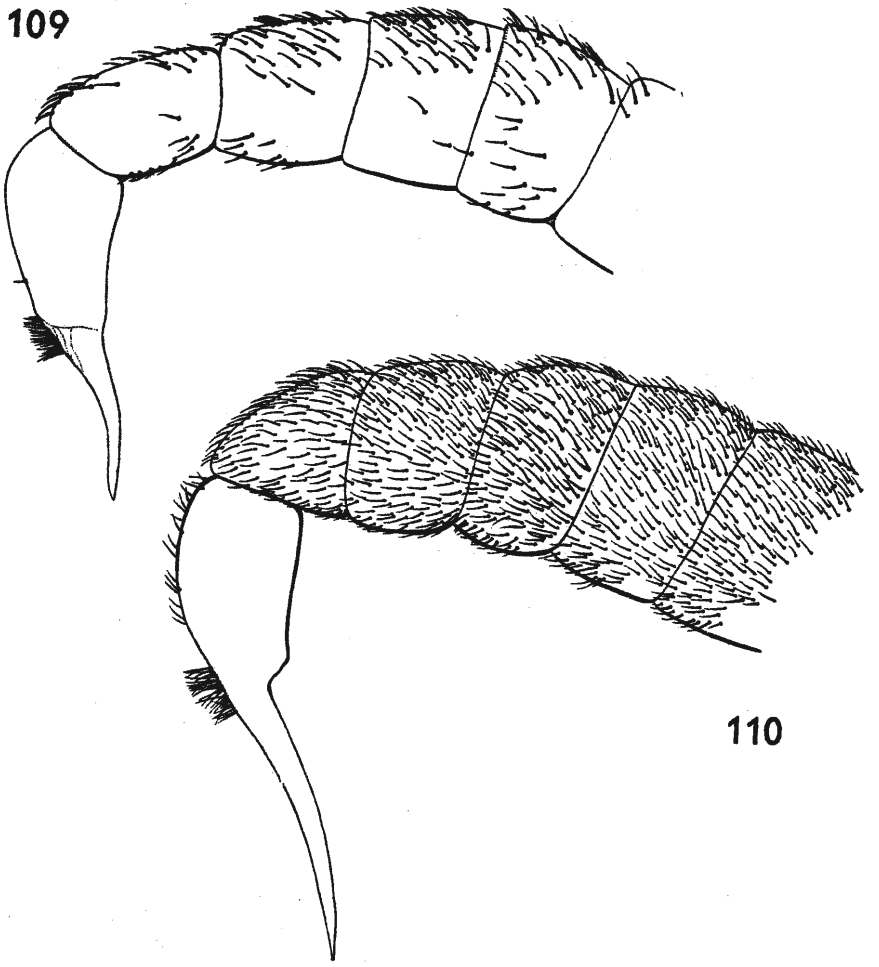
– Thorax on disc with grey or brownish-grey dusting extending back (at least in separate stripes) from anterior margin to a point at least as far as the wing bases, beyond which the shining black ground colour is usually more or less exposed ; ovipositor resembling that of *phaeton* ♀, but piercer sometimes rather more strongly downcurved. (Wing length, distribution and dates, see ♂)
campestris Latreille ♀

10 Tibiae mainly or entirely yellow ; frons completely grey-dusted, dull, only frontal triangle shining 11

— Tibiae mainly darkened 12

11 Front and mid femora extensively yellow, hind pair usually so ; ovipositor (fig. 105) with base deep, strongly convex below, shorter than piercer, which is strongly downcurved. (Wing length, distribution and dates, see ♂) . . **varipes** Meigen ♀

— All femora black except at extreme base and tip ; ovipositor (fig. 107) with base moderately deep, slightly convex below, shorter than piercer, which is at most very slightly downcurved. (Wing length, distribution and dates, see ♂)
thomsoni Becker (*pratorum* Verrall *et alia*, nec Fallén) ♀



FIGS. 109–110.—*Pipunculus*, female ovipositor. 109, *phaeton* ; 110, *zugmayeriae*.

12 Tergites dull grey-black on disc, 1 and sometimes base of 2, heavily grey-dusted ; pubescence of tergites dense, short, pale yellowish.....13

— Tergites glittering black on disc, except for 1, which is heavily grey-dusted ; 2, which is grey or greyish-yellow-dusted on anterior two-thirds, or more or less ; 3, which sometimes has a restricted patch of dusting on disc towards base ; pubescence of tergites sparse, short, pale yellowish ; viewed from front, thorax entirely brownish-grey dusted ; all tibiae yellow for less than basal half, and more or less narrowly so at tip, otherwise darkened ; tarsi with at least last segment darkened ; wing with stigma very short, much shorter than next costal segment ; ovipositor (fig. 106) with base short, quite deep, slightly convex below, piercer short, subequal in length to base, slightly downcurved. (Wing length, distribution and dates, see ♂) (see footnote) .....**fonsecai** sp. n. ♀[1]

13 Tibiae clear yellow for at least basal third ; femora considerably thickened ; last section of M_{1+2} only slightly undulating ; stigma as long as the next costal section ; halteres yellowish ; ovipositor (fig. 108) with base rather deep, quite strongly convex below, not or scarcely ridged above at tip, shorter than piercer, which is very slightly downcurved ; wings noticeably long in proportion to body. (Wing length, distribution and dates, see ♂).....**spinipes** Meigen ♀

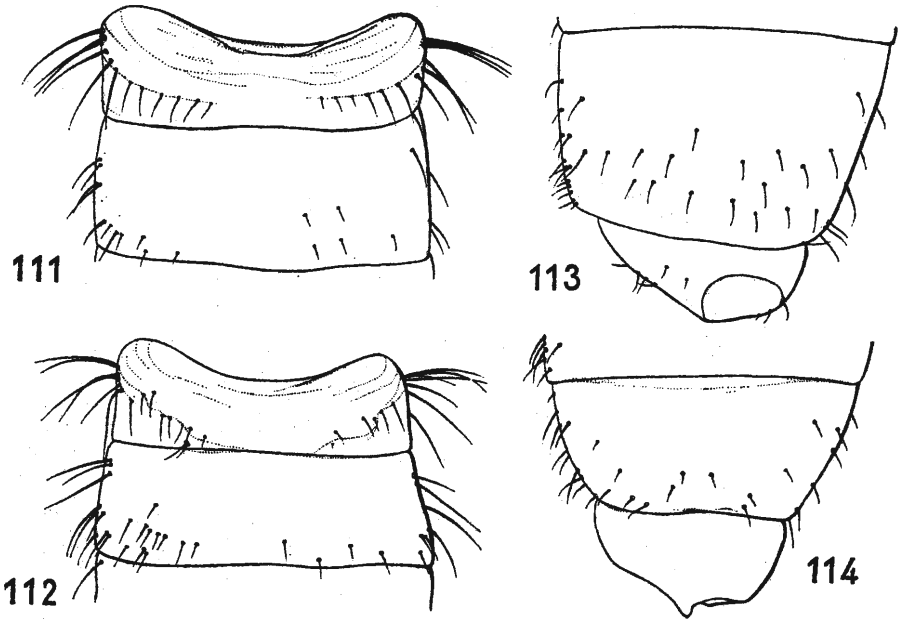
Tibiae clear yellow at extreme base only, any more extensive pale area being obscured by grey dusting ; femora only moderately thickened ; last section of M_{1+2} considerably undulating ; stigma much shorter than next costal section ; halteres blackish ; ovipositor (fig. 110) with base rather shallow, moderately convex below, abruptly and considerably ridged above at tip, shorter than piercer, which is quite strongly downcurved ; wings not noticeably long in proportion to body. (Wing length, distribution and dates, see ♂).....**zugmayeriae** Kowarz ♀

Genus **Cephalops** Fallén

In size our *Cephalops* cover a wider range than other British genera of the family, varying in wing length from 3·5 to 7·25 mm. Some species are quite dull in both sexes, superficially resembling *Eudorylas*, while others are more or less extensively shining ; in some species the males are shining to some extent, while the females are partly or entirely dullish grey. *C. semifumosus* has the distinction of being the only British Pipunculid that is frequently taken *in copula*. Such mated pairs are only rarely found in the other species, which is a considerable disadvantage when one attempts to match individuals of species with dimorphic sexes. In 1964 Dr. Burtt took on Goring Heath, Oxford, several pairs of *semifumosus in copula*, some hovering while mated, others resting so on the leaves of shrubs. In the same year I caught several mated couples flying low among barley stubble at the edge of a field at Addington, Surrey, while in the British Museum there are examples of the same species taken *in copula* by four other collectors.

Records of parasitism by various species of *Cephalops* in Europe and elsewhere are quite numerous, and in every instance where the host Homopteron has been identified the latter has belonged to the family Delphacidae. All the numerous Hawaiian species of Pipunculidae are *Cephalops*, according to Hardy (1964 : 303), and the hosts so far as they are known are exclusively Delphacidae. Breeding records of European species of *Cephalops* determined by myself are as follows: *C. furcatus*, Berks. (Wytham), 1 ♀ from pupa in soil under oak, em. 8.vi, G. C. Varley. *C. germanicus*, same data, 1 ♀ em. 6.vi. *C. semifumosus*, Buckingham. (Burnham Beeches), ? sex, bred from nymph of *Ditropis pteridis* Boheman (Delphacidae), 19.vi, em. 17.vii, O. W. Richards ; Berks. (Sunninghill), 1 ? sex, bred from *Conomelus anceps* Germar

[1] *Pipunculus fonsecai* sp. n. A female that I took at Addington, Surrey, on 12.viii.1965 may be referable to this species, from which it differs in having the piercer of the ovipositor quite straight and rather longer.



FIGS. 111–114.—111–112, *Cephalops* ♂, tergite 1, showing lateral fan of bristles. 111, *furcatus*; 112, *germanicus*. 113–114. *Cephalops* ♂, tergite 5 to tip of abdomen, from above. 113, *furcatus*; 114, *germanicus*.

(Delphacidae), em. 20.viii, G. Rothschild ; Carnarvon. (Bangor), 1 ♀, bred from *C. anceps* (Delphacidae), em. ix, P. Whalley. *C. oberon* sp. n., Buckingham., 1 ♂ bred from nymph of *D. pteridis* (Delphacidae), 18.vi., em. 16.vii, O. W. Richards. *C. subultimus*, Berks. (Windsor Forest), 1 ♂ bred from nymph of *D. pteridis* (Delphacidae), em. 11.vii, O. W. Richards. *C. ultimus*, Germany, 2 ♂ bred from *Eurysa lineata* Perris (Delphacidae), em. iii–iv, Drs. H. Strübling and H.-J. Müller. *C. chlorionae* Frey (non-British), Finland, series bred from nymphs of *Chloriona glaucescens* Fieber (Delphacidae), em. vi–viii, H. Lindberg (1946 : 1–50).

In the following key I describe three species, *curtifrons*, *oberon* and *titania*, as new to science, bringing the total of our British *Cephalops* to 13.

KEY TO SPECIES

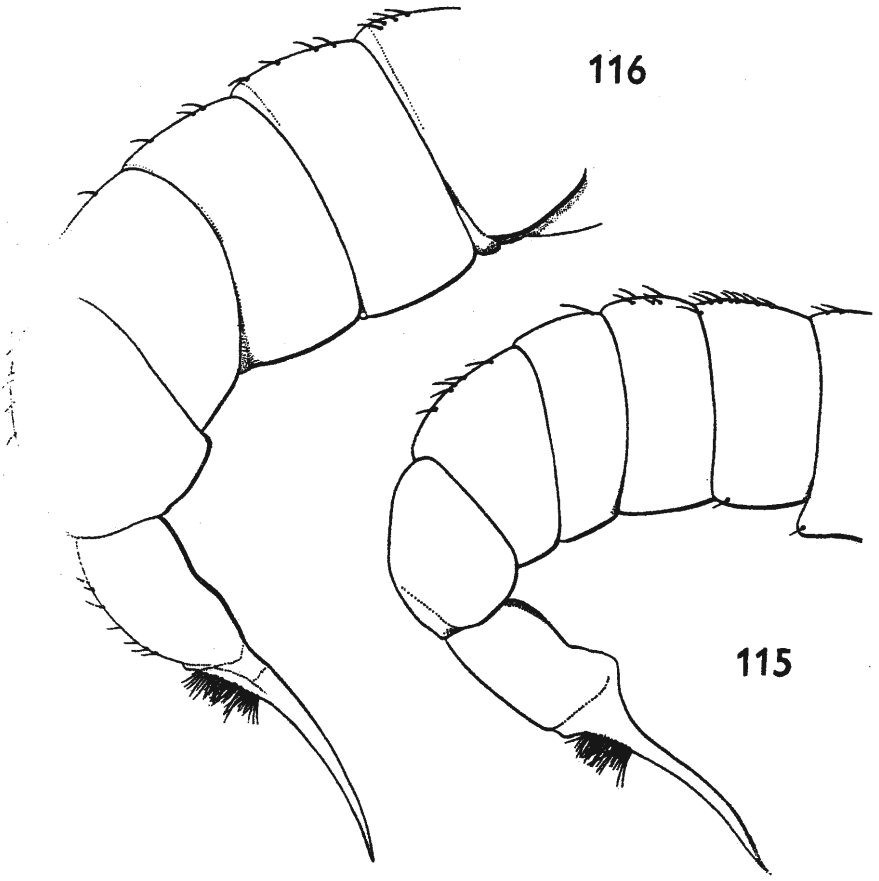
1 Vein M_{1+2} (fig. 117) with an appendix of varying length.....2
– Vein M_{1+2} (fig. 133) without an appendix (except rarely in aberrant examples)....3
2 ♂ viewed from above, tergites 2–4 are with contrasting blackish anterior and brownish-grey posterior bands ; tergite 1 (fig. 111) has a lateral fan of 5–8 fairly long stiff brownish bristles contrasting with the shorter and finer pale hairs on succeeding tergites ; tergite 5 (fig. 113) only moderately wider than long, narrowly black anteriorly, greyish-brown behind ; hind tibiae with a yellow somewhat triangular ventral projection apically ; tibiae and tarsi mainly yellowish. ♀ viewed from above, tergites 2–4 are light grey, sometimes black or brown banded anteriorly, and traces of latter coloration may spread over disc ; base of ovipositor (fig. 115) fairly deep, with an apical large brown protuberance above

which appears rounded from side view. ♂♀ wing length 5·5–7·25 mm.

furcatus Egger

Moray., Argyll., Suffolk, Hereford., Gloucester., Wilts., Berks., Hants., Surrey, Kent, Sussex. v–vii.

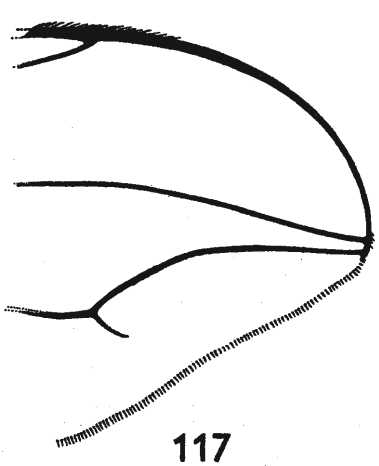
– ♂ viewed from above, tergites 2–4 are without contrasting bands on dorsum, but often more or less extensively darkened anteriorly, otherwise chocolate or dark brown ; antennae with third segment smaller and blunter than in *furcatus* ♂ ; tergite 1 with the lateral fan (fig. 112) differing from that of *furcatus* ♂ in being composed of finer whitish bristly hairs, not sharply exceeding in thickness and length the longer of the hairs on succeeding tergites ; tergite 5 (fig. 114) about 1½ to 2 times as wide as long ; hind tibiae without an apical projection ; tibiae (and sometimes tarsi) more or less extensively darkened. ♀ viewed from above, tergites 2–4 are chocolate-brown or dark brownish-grey, often more or less extensively darkened anteriorly, and light grey towards sides ; antennae with third segment in this sex even more noticeably smaller and shorter than in *furcatus* ♀ ; lateral fan of tergite 1 as in ♂ ; base of ovipositor (fig. 116) quite shallow, flattened above and without any obvious apical protuberance. ♂♀ wing



FIGS. 115–116.—*Cephalops*, female ovipositor. 115, *furcatus* ; 116, *germanicus*.

length 5·25–7·0 mm.....**germanicus** Aczel[2]
Westmorland, Worcester, Cambridge., Suffolk, Hereford., Oxford., Gloucester., Glamorgan., Berks., Hants, Kent, Devon., Sussex, Cornwall. v–vii (see foot-note).

3 All femora brightly polished behind along lower part for almost entire length ; all femora black except at base and tip ; all tibiae more or less darkened or at least obscured about middle ; last section of M_{1+2} only slightly undulating ; wing length 4–5 mm. ♂ viewed from above, tergites 1–3 dull, 4 and 5 shining except at extreme base : abdominal segment 8 at maximum length about half that of tergite 5, moderately greyish-yellow dusted, membraneous area rather large, triangular, occupying nearly half width of segment. ♀ frons widening considerably towards middle.....**obtusinervis** Zetterstedt
Inverness., Fife, Dumbarton., Dumfries., Isle of Man, Yorks., Lancs., Cheshire, Shropshire, Oxford., Herts., Hants., Surrey, Kent, Devon., Sussex. v–vii.



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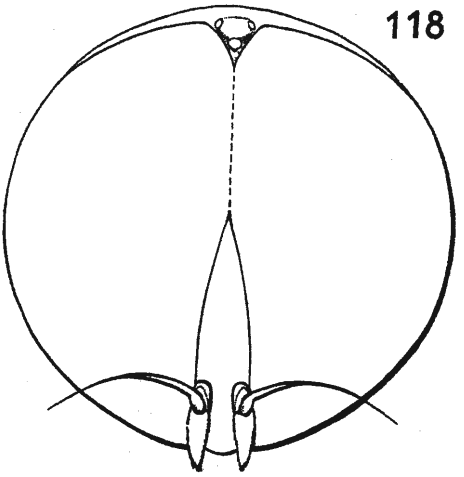

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FIGS. 117–118.—117, *Cephalops furcatus*, tip of wing. 118, *C. oberon* ♂, frons and antennae, anterodorsal view.

– Only hind femora polished behind, other pairs dullish, or femora more extensively yellow.....4

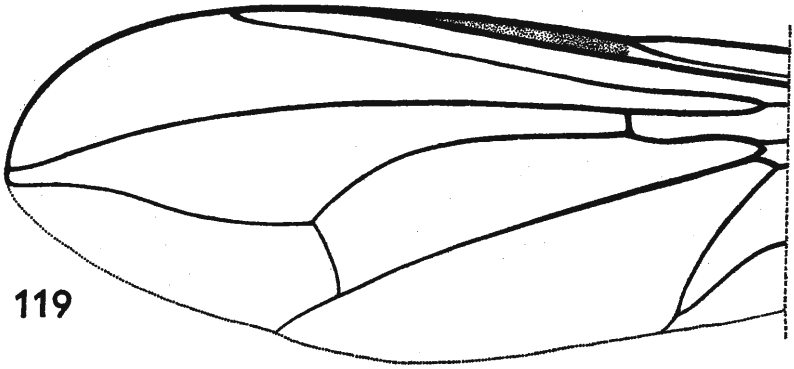
4 Viewed from behind, tergites 2–4 have the conspicuous light grey side-markings spreading on to dorsum, in ♂ and often in ♀ becoming dark grey or brownish on actual disc, thus forming posterior cross-bands, contrasting with the black ground-colour ; femora black except at base and tip ; tibiae with or without a

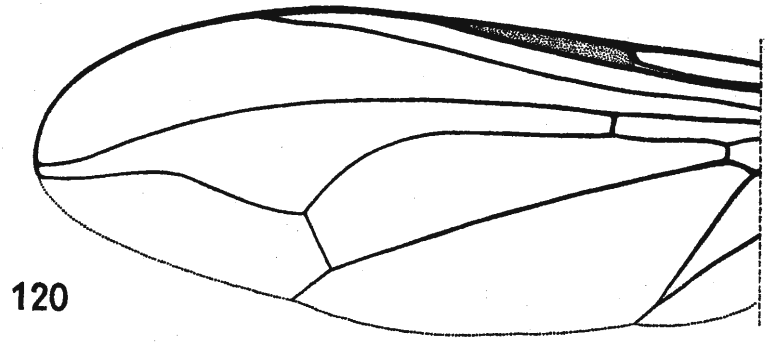
[2] *Cephalops germanicus* Aczel. From Aczel's (1940 : 164) description I am satisfied that his *germanicus* and our second British species with the forked M_{1+2} are identical. It appears, unfortunately, that Aczel's type of *germanicus* cannot now be traced, and was probably destroyed during or following the 1939–45 war. According to Dr. F. Mihályi (*in litt.*), of the Hungarian Natural History Museum, Budapest, when Aczel emigrated to South America after the war most of his Pipunculid collection remained in the garret of his lodgings in Budapest. In 1957 the material was removed to the museum mentioned above, by which time much of it had been destroyed by pests, and Mihályi failed to find material of *germanicus* among the surviving specimens. Again, according to Mihályi, a further part of Aczel's collection was in the (Hungarian) Institute of Agricultural Entomology when that building was totally destroyed in the hostilities of 1945. Described from material taken in Germany, *germanicus* has been subsequently taken in Sweden and so identified by Ringdahl, and I have identified as the same species a male taken by Mr. G. S. van der Goot in Holland. In Britain it occurs about as frequently as its close ally, *furcatus* Egger.

slight darkening after middle, hind pair with 2–5 long black bristly hairs anteriorly on middle third ; wing length 5–6·5 mm. ♂ frons much longer than antennae. **carinatus** Verrall

Perth. (*Perth*), *E. Brunetti; Worcester.* (*Wyre Forest*), *G. H. Verrall; Hereford.* (*Shobdon Marsh*), *J. H. Wood; Herts.* (*Felden*), *A. Piffard; Kent* (*Tunbridge Wells*), *C. G. Nurse;* (*Barming*), *E. B. Basden; Sussex* (*Crowborough*), *F. Jenkinson. vii–ix.*

– Viewed from behind, tergites 2–4 with any brownish-grey or grey side-markings only spreading vaguely on to disc (if at all), and when such is the case the femora are mainly or entirely yellow.....5





FIGS. 119–120.—*Cephalops*, wing. 119, *vittipes* ; 120, *aeneus*.

5 Tergite 2 completely, 1 and 3 partly, pale yellow at sides, this coloration extending to dorsum ; femora, tibiae and tarsi, except last segment of latter, clear yellow ; antennae with segments 1 and 2 blackish-brown, 3 yellow ; wing length 5 mm. (single example measured).....**perspicuus** de Meijere ♂ (♀ apparently unknown)

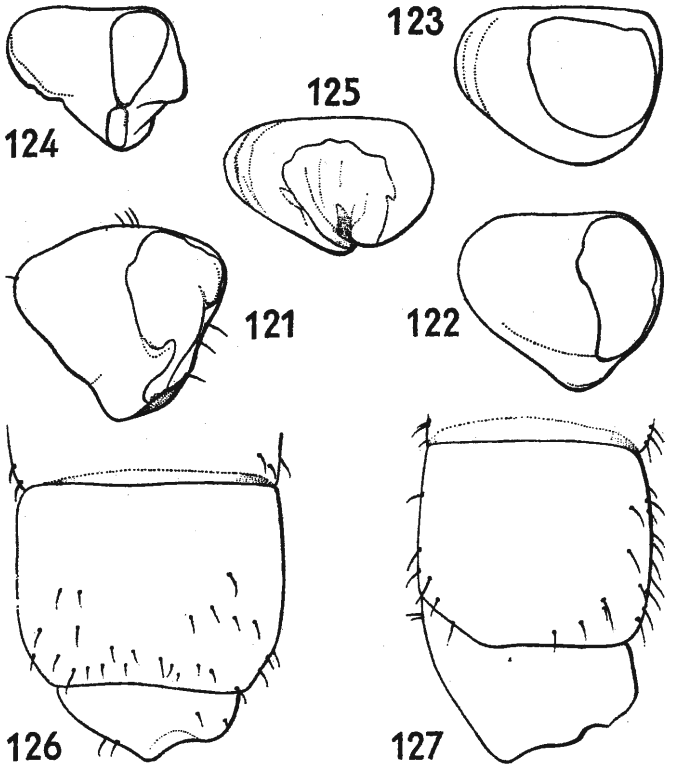
Norfolk (*Horning Ferry*), *J. E. Collin* (*?* 1) ♂, *vi–vii* (exact date not available at present).

– Tergites not at all yellow.....6

Frons strikingly short, not longer than antennae ; viewed from above, tergites 1 and 2 dull greyish-brown, 3–5 shining brownish-black; abdominal segment 8 shorter than tergite 5, membraneous area quite small, oval, occupying less than right half of segment ; coxae greyish, femora dull greyish-black, broadly yellowish at base and tip, last tarsal segment darkened, legs otherwise yellowish. Wing length 5·25 mm. (single example measured).....**curtifrons** sp. n. ♂ (♀ unknown)

Holotype ♂ ; *Cambridge.* (*Woodditton Wood*), 8.vii.1953, *E. A. Fonseca*

– Frons considerably longer than antennae 7
7 Males 8
– Females 14
8 Viewed from above, tergite 3 is shining on disc, at least posteriorly 9
– Viewed from above, tergites 2 and 3 are absolutely dull on disc (if rubbed, irregular shining patches will appear) ; wings not exceptionally long in proportion to body; abdominal segment 8 with the membraneous area connected ventrally by a more or less narrow cleavage in the integument to the ninth (hypopygial) segment (a peculiarity that is also found in *carinatus* ♂ and *oberon* ♂ (a narrow cleavage) and *perspicuus* ♂ (a wide cleavage)) 11

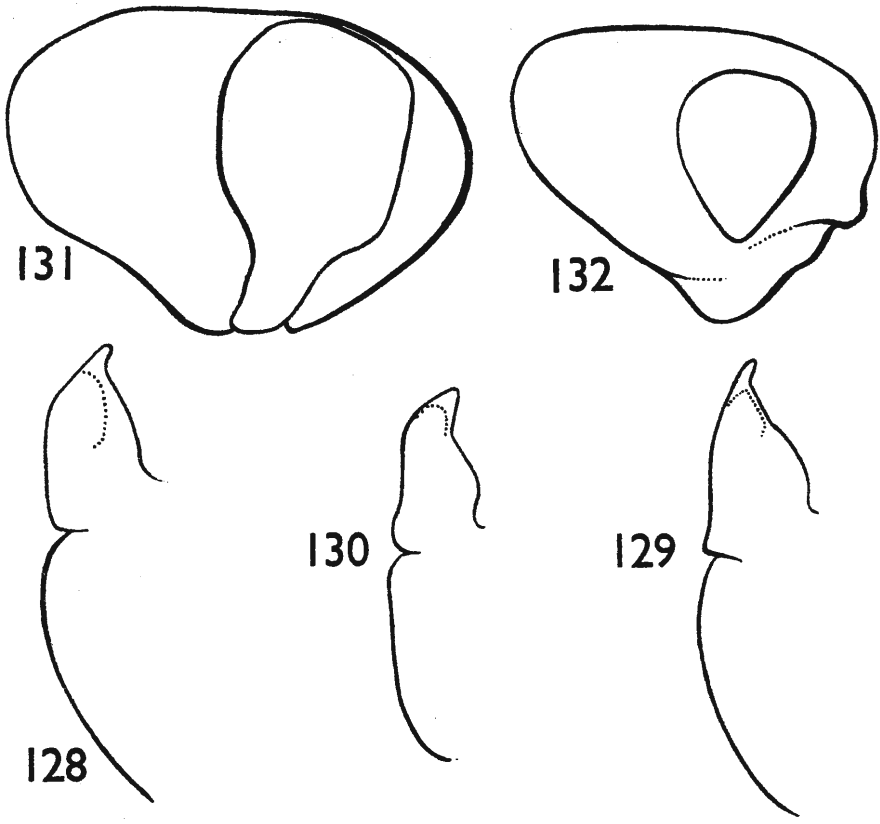


FIGS. 121–127.—*Cephalops* ♂, abdominal segment 8 (121–125, from behind ; 126–127, from above). 121, *oberon* ; 122, *vittipes* ; 123, *aeneus* ; 124, *ultimus* ; 125, *subultimus* ; 126, *vittipes* ; 127, *aeneus*.

9 Femora extensively darkened about middle ; wings not exceptionally long in proportion to body ; eyes touching for a distance at least equal to length of frons (fig. 118), which from front view is dark grey to blackish for about posterior half to two-thirds, light grey or yellowish-grey anteriorly ; antennae with third segment very shortly pointed, light yellowish-brown ; abdominal tergites 2 and 3 shining black on disc at least posteriorly ; segment 8 (fig. 121) with a large deep membraneous area extending practically full depth of segment, roundish or oval, nearly half as wide as the segment, connected ventrally by a narrow cleavage in the integument to the ninth (hypopygial) segment; viewed from above, segment 8 is at maximum length at least half as long as tergite 5, quite brightly shining with very light greyish-yellow dusting, which is at least obvious from above ; wings with stigma slightly longer than next costal section ; wing length 5–5·5 mm.
oberon sp. n. ♂ (♀ unknown)

Holotype ♂: *Berks.* (*Bagley Wood*), 2.ix.1962, *M. Ackland.* Paratypes : *Oxford.* (*Goring Heath*), 4.viii.1964, *E. Burtt*, 1 ♂ ; *Gloucester.* (*Inglestone Common*), 18.viii.1962, *M. Ackland*, 1 ♂ ; *Surrey* (*Warlingham*), 5.viii.1954, *R. L. Coe*, 3 ♂ ; *E. Kent* (*Eastling Wood*), 29.vii.1953, *E. A. Fonseca*, 1 ♂. Other Material : *Buckingham., Berks., Somerset* (*Shapwick*), *E. Kent* (*Woolwich Wood*). *v–viii.*

– Femora completely yellow, or rarely at extreme base with a small blackish spot above, which may spread more or less vaguely along dorsal surface ; wings unusually long in proportion to body ; eyes touching for a distance at least 1¼ times length of frons ; antennae with third segment absolutely blunt ; tergite 1 with a lateral brush of rather long, usually pale, sometimes darkened, bristly hairs at base ; eighth abdominal segment with the apical membraneous area completely isolated from the ninth (hypopygial) segment.....10



FIGS. 128–132.—128–130. *Cephalops* ♂, genital style. 128, *subultimus* ; 129, *titania* ; 130, *semifumosus*. 131–132. *Cephalops* ♂, abdominal segment 8, from behind. 131, *titania* ; 132, *semifumosus*.

10 Wing (fig. 119) with last section of M_{1+2} scarcely undulating, not or scarcely concave behind, stigma exceptionally long, about twice as long as next costal section ; viewed from side, all or some of tergites 2–4 appear more or less extensively dulled by greyish or brownish lateral dusting ; abdominal segment 8 (fig. 122) with a moderate sized rather deep membraneous area, extending practically full depth of segment, roundish or oval ; viewed from above (fig. 126) latter segment is at

its maximum length not more than one-fourth or at most one-third as long as tergite 5, moderately shining, lightly greyish-yellow dusted ; frons dark grey from front view ; antennae small, light yellowish to yellowish-brown ; wing length 6–7 mm.....**vittipes** Zetterstedt ♂

Yorks., Cambridge., Hereford., Gloucester., Oxford., Berks., Somerset, Hants., Surrey, Sussex. v–viii.

— Wing (fig. 120) with last section of M_{1+2} undulating, quite strongly concave behind on middle third, stigma only about 1¼ to 1½ times as long as next costal section ; viewed from side, tergites 2–4 are extensively shining black with grey dusting practically restricted to posterior corners ; otherwise differs from *vittipes* ♂ as follows: membraneous area (fig. 123) of abdominal segment 8 larger and more evenly rounded, this segment (fig. 127) longer, at maximum length quite half as long as tergite 5 ; wing length 4·25–6·5 mm....**aeneus** Fallén (*flavipes* Meigen) ♂

Perth., Midlothian, Warwick., Worcester., Cambridge., Hereford., Oxford., Berks., Somerset, Hants., Surrey, Kent, Dorset, Sussex. S. Ireland. v–ix.

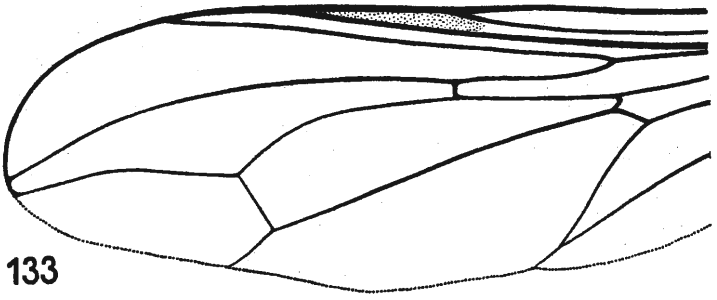


FIG 133.—*Cephalops titania* ♀, wing.

11 From all angles, tergites 2–4 are completely dull : abdominal segment 8 (fig. 124) with membraneous area quite small and rather shallow, extending practically full depth of segment, roundish or oval ; viewed from above, latter segment is at maximum length about half as long as tergite 5, moderately shining, very sparsely and lightly greyish-yellow dusted ; eyes touching for a distance equal to or slightly more than length of frons, which from front view is blackish for about posterior half to two-thirds, darkish grey anteriorly ; tergite 1 with a lateral brush of short pale (sometimes brownish tinged) bristly hairs at base ; wing with stigma about 1¼ to 1½ times as long as next costal section ; antennae small, third segment blunt or very shortly pointed, brownish-grey ; femora more or less broadly yellow at base and tip, otherwise darkened ; tibiae yellow, usually more or less distinctly darkened after middle ; tarsi yellow with last segment darkened, occasionally more extensively obscured ; wing length 4–5 mm.

ultimus Becker ♂

Generally distributed. vi–ix.

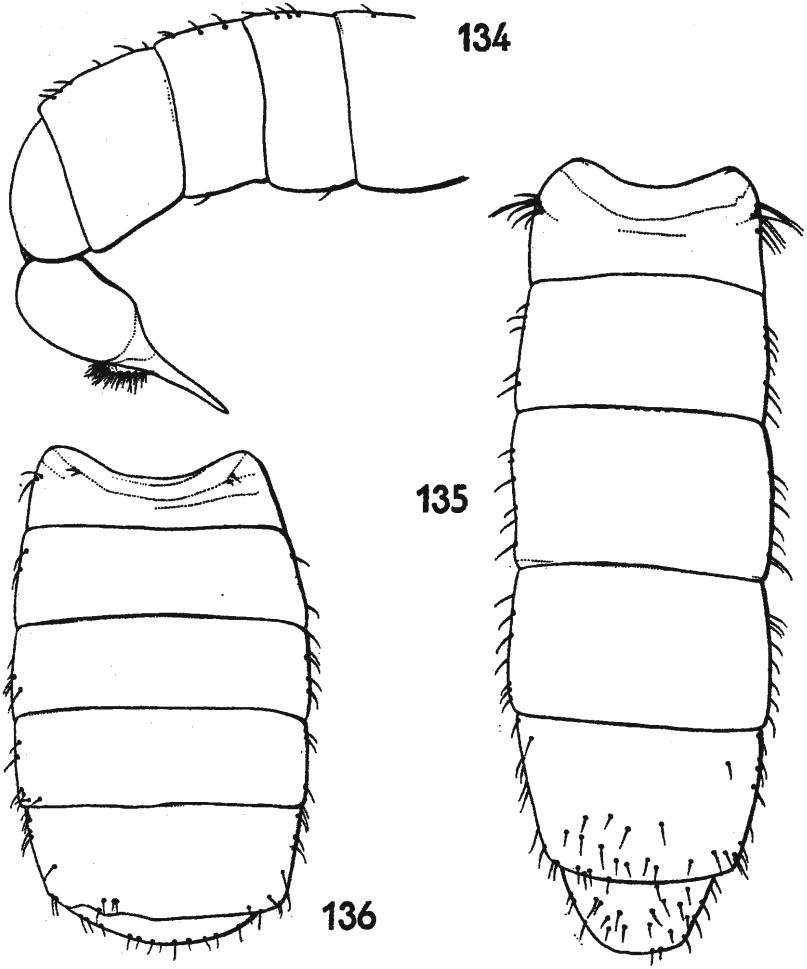
— Viewed from above, tergite 4 is partly or entirely glittering black ; abdominal segment 8 with degree of shining and dusting, also brush of tergite 1, as in *ultimus* ♂ ; length of stigma varying within a species from equal to next costal section to 1¼ or 1½ times the length of latter.....12

12 Abdominal segment 8 with membraneous area not nearly occupying half width of segment, moderate sized or small, oval or rounded, but not usually widely rounded at upper extremity ; frons darkish grey from in front, except for supra-antennal silvery area ; coxae dark, trochanters yellow, all femora extensively darkened, broadly yellow-tipped, at least hind pair also broadly yellow at base ; tibiae clear yellow or vaguely darkened after middle ; tarsi yellow, apart from darkened last segment or two ; wings not strikingly longer than body.....13

— Abdominal segment 8 (fig. 125) with membraneous area occupying nearly or quite half width of segment, quite large, widely rounded above ; the segment itself quite large, slanting inwards and rather squarish-ended on left, more projecting and more rounded on right, where its length is rather less than half that of tergite 5 ; genital style (fig. 128) ; frons blackish from in front, except for supra-

antennal silvery area ; femora with the dark markings more restricted and usually less distinct than in *titania* ♂ and *semifumosus* ♂ ; tibiae clear yellow, tarsi yellow apart from darkened last segment ; eyes touching for about length of frons or moderately more or less ; antennae small, bluntly pointed, light yellowish-brown to dark brown ; wings strikingly longer than body ; wing length 4·25–5·25 mm..... **subultimus** Collin ♂

Sutherland., Banff., Hereford., Gloucester., Oxford., Berks., Somerset, Hants., Surrey, Kent, Sussex. S. Ireland. vi–ix.

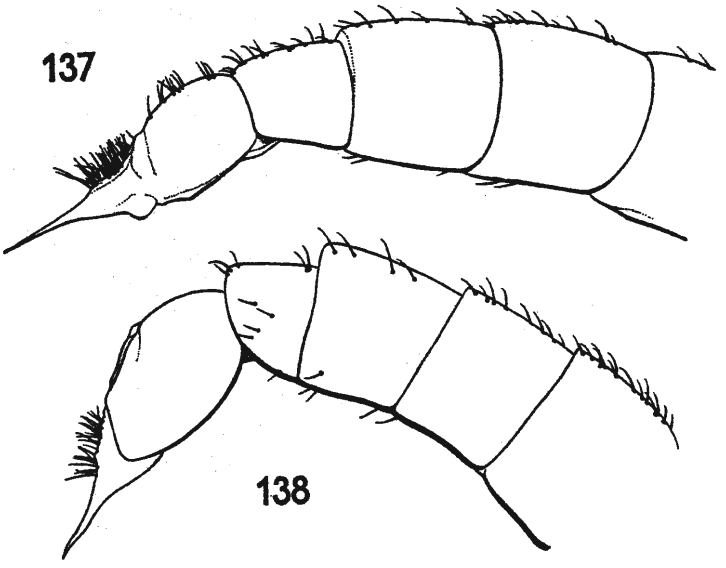


FIGS. 134–136.—134, *Cephalops titania*, female ovipositor. 135–136, *Cephalops* ♀, abdomen, from above. 135, *vittipes* ; 136, *semifumosus*.

13 Abdominal segment 8 quite large and longish, at maximum length at least half as long as tergite 5, very obliquely sloping inward and not at all rounded on left, rounded on the right ; membraneous area (fig. 131) roughly oval, moderate sized ; genital style (fig. 129) ; eyes touching for a noticeably long distance, equal to about 1¼ to 1½ times length of frons ; antennae small, third segment distinctly but shortly pointed, yellowish-grey to dark grey ; wing length 4–5·25 mm ..... **titania** sp. n. ♂

Holotype ♂ : *Surrey* (*Addington*), 12.viii.1965, *R. L. Coe*. Paratypes : *Hereford.* (*Devereux Woods*), 16.viii.1902, *J. H. Wood*, 1 ♂ ; (*Woolhope*), 14.vii.1908, *same collector*, 1 ♀ ; *Stafford.* (*Maer Woods*), 17.viii.1936, *H. Britten*, 1 ♂, 1 ♀ ; *Hants.* (*Exbury*), 30.vii.1963, *C. H. Andrewes*, 1 ♂. Other Material : *Midlothian, Cheshire, Norfolk, Cambridge., Oxford., Berks., Somerset, Surrey, E. Kent. vi–x.*

— Abdominal segment 8 smaller, short, at maximum length less than half as long as tergite 5, inclined to be more evenly rounded, although oblique on the left ; membraneous area (fig. 132) small, oval ; genital style (fig. 130) ; eyes touching for a distinctly shorter distance compared with length of frons (than in *titania* ♂) ; antennae small, third segment at most very shortly pointed, yellowish-brown to dark brown ; wings shorter and inclined to be more rounded at tip ; wing length 3·5–4·75 mm.....**semifumosus** Kowarz (*strobli* Verrall, *strigulipes* Verrall) ♂
Generally distributed. vi–x. (Audcent, 1934 : 41).



FIGS. 137–138.—*Cephalops*, female ovipositor. 137, *vittipes* ; 138, *aeneus*.

14 Body rather long and slender, portion visible from above of each of tergites 2–4 (fig. 135) about twice as wide as long ; wings noticeably long in proportion to body ; femora and tibiae completely yellow.....15

— Body short and robust, portion visible from above of each of tergites 2–4 (fig. 136) at least three times as wide as long ; wings not noticeably long in proportion to body.....16

15 Viewed from above, tergite 2 is obscured with greyish dust, although not so heavily as tergite 1 ; last section of M_{1+2} scarcely undulating, not or only slightly concave behind ; stigma much longer than next section of costa ; ovipositor (fig. 137). (Wing length, distribution and dates, see ♂).....**vittipes** Zetterstedt ♀

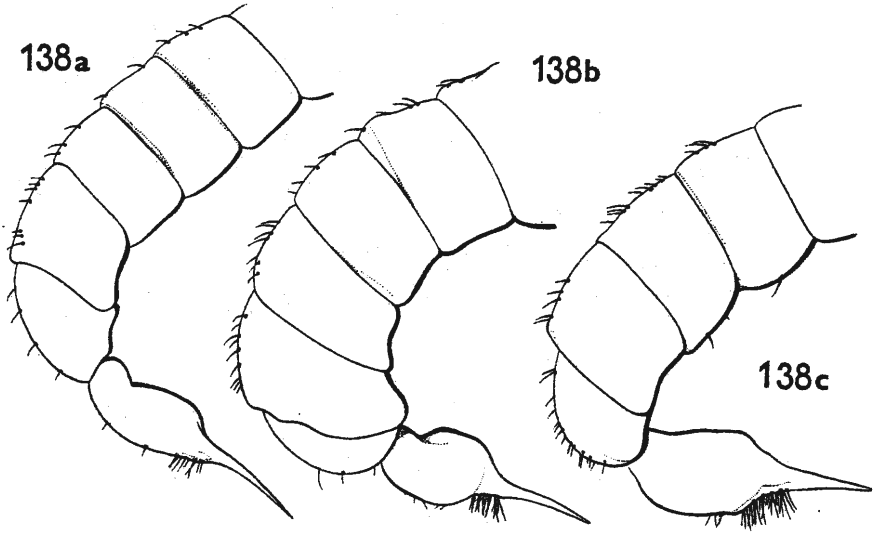
— Viewed from above, tergites 2–5 are glittering black, quite undusted ; last section of M_{1+2} undulating, quite strongly concave behind, at least on middle third ; stigma about as long as next section of costa, or slightly shorter ; wings broader and less long than in *vittipes* ♀ ; ovipositor (fig. 138). (Wing length, distribution and dates, see ♂).....**aeneus** Fallén (*flavipes* Meigen) ♀

16 Femora completely yellow, or at most with a faint brownish streak ; tibiae and tarsi yellow, except last tarsal segment more or less darkened.....17

— At least hind femora with a more or less broad distinct blackish ring ; mid femora with at least a blackish dorsal streak, sometimes obscured by dusting ; ovipositor with piercer straight and rather short.....18

17 Ovipositor (fig. 138*a*) with base shallow, only slightly if at all rounded below, somewhat concave or flattish above, sometimes with a small dark protuberance at tip, shorter than the long almost straight piercer. (Wing length, distribution and dates, see ♂).....**ultimus** Becker ♀

— Ovipositor (fig. 138*c*) with base rather deep, rather strongly convex below, at most only slightly so above, usually with small brown protuberance at tip, subequal in length to the short almost straight piercer. (Wing length, distribution and dates, see ♂).....**subultimus** Collin ♀



FIGS. 138*a–c*.—*Cephalops*, female ovipositor. 138*a*, *ultimus*; 138*b*, *semifumosus*; 138*c*, *subultimus*.

18 Ovipositor (fig. 138*b*) with base shallow at first and concave above, then becoming deep and convex above on more than apical half, ventral side gently rounded; R_{2+3} meeting costa at a point level with, or only slightly beyond, upper end of marginal cross-vein (fig. 24). (Wing length, distribution and dates, see ♂) **semifumosus** Strobl (*strobli* Verrall, *strigulipes* Verrall) ♀

– Ovipositor (fig. 134) with base deep throughout, somewhat concave above with a more or less obvious protuberance at tip, ventral side quite strongly rounded; R_{2+3} meeting costa at a point well beyond level of upper end of marginal cross-vein (fig. 133). (Wing length, distribution and dates, see ♂)....**titania** sp. n. ♀

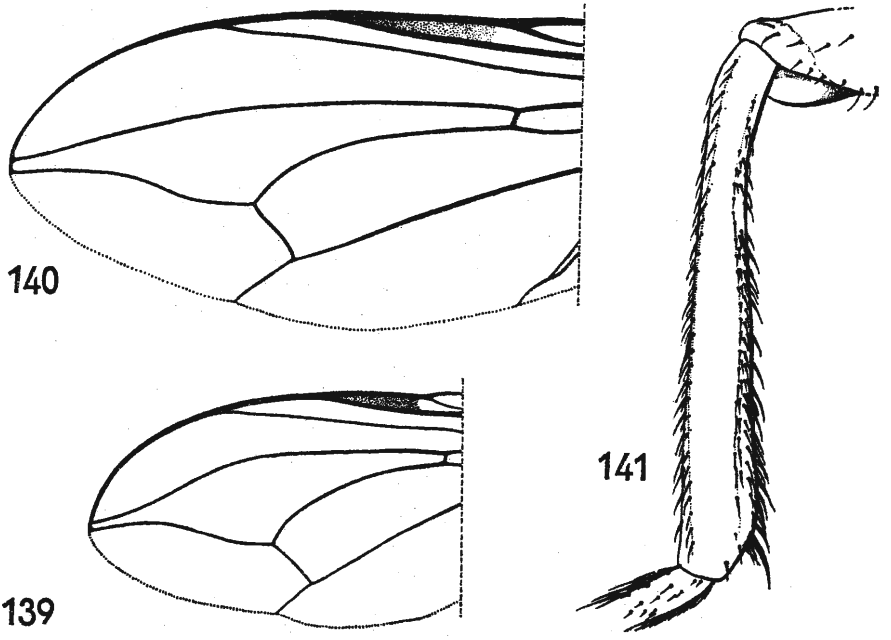
Genus **Eudorylas** Aczél

Usually dull brownish or brownish-black flies of small to large size, varying in wing length from 3·5 to 6·0 mm. They occur in various situations, including wooded areas and at borders of fields. The present writer took both sexes of *E. subterminalis* in considerable numbers on a warm June evening towards sunset flying low among the stems of wheat plants in a corner of a field. In mid-September on a cool dull day, when one would not expect Pipunculidae to be on the wing, I took a long series of *E. obliquus* hovering very low among bracken in a woodland clearing.

In late March Scott (1908 : 9–11) found in some rotten wood a puparium from which emerged on 10th May a male of *E. melanostolus* (see under *Descriptions of Early Stages*). Four males and a female of the same species

emerged in June and July from puparia found in soil under an oak by Professor G. C. Varley of Oxford University ; also from the same material there emerged in April a male of *E. subfascipes*. R. C. L. Perkins (recorded by Scott, 1925*b* : 162–3) bred two males and a female of *E. horridus* from a nest of *Crossocerus* (*Coelocrabro*) *pubescens* Shuckard (Hym., Sphecidae) in a stem of *Typha*.

From the numerous records of parasitism by various species of *Eudorylas* the fact emerges that the Homopteron hosts selected belong with a single exception (the Australian species, *E. helluo* Perkins—see under *Life-History*) to the family Cicadellidae (Jassidae). Breeding records of European species of *Eudorylas* determined by myself are as follows: *E. fuscipes*, Germany,



FIGS. 139–141.—139–140, *Eudorylas* ♂, part of wing. 139, *halteratus* ; 140, *melanostolus*. 141, *E. zonellus*, right front tibia, externolateral view.

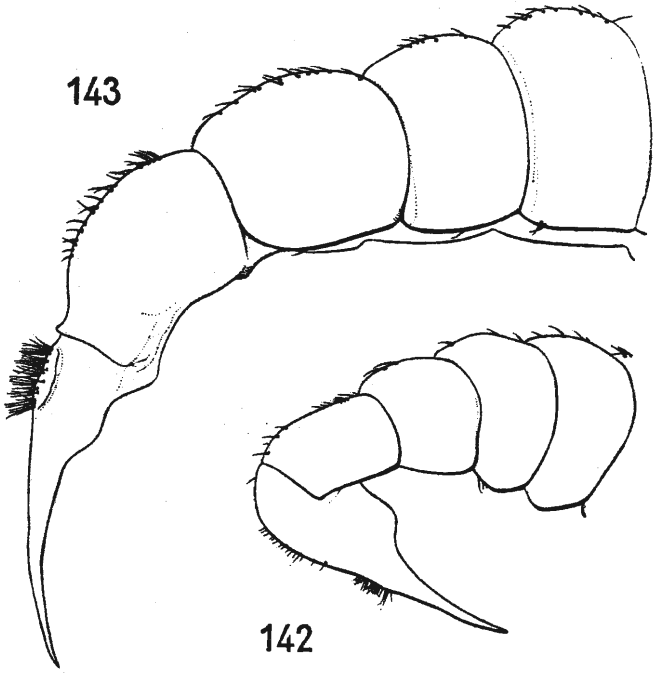
1 ♀ bred from *Macrosteles variatus* Fallén (Cicadellidae), em. 11.iv., H. Strübling and H.-J. Müller ; 1 ♀ bred from *M. laevis* Ribaut (Cicadellidae), same collectors. *E. obliquus*, Germany, 3 ♀ bred from *Speudotettix* (as *Thamnotettix*) *subfusculus* Fallén (Cicadellidae), em. 15.iv–17.v., same collectors; 1 ♀ bred from *Cicadula quadrinotata* Fabricius (Cicadellidae), same collectors. *E. ruralis*, Germany, 1 ♀ bred from *Euscelis plebejus* Fallén (Cicadellidae), same collectors ; 3 ♂, 6 ♀ bred from *E. plebejus incisus* Kirschbaum (Cicadellidae). em. iv–vi, same collectors. *E. montium*, Germany, 3 ♂ bred from *Cicadula quadrinotata* Fabricius (Cicadellidae), em. v, same collectors. *E. longifrons*, Germany, 1 adult bred from *Mocydia crocea* Herrich-Schaeffer (Cicadellidae), em. 15.iv, same collectors. Also *E. fuscipes* (identification not checked by me), Sweden, 1 adult bred from

Elymana sulphurella Zetterstedt (as *Thamnotettix virescens* Fallén) (Cicadellidae), em. vi, C. H. Bohemann (1854 : 302–5) ; and Finland, adults of same species bred from same host, vii–viii, H. Lindberg (1946 : 1–50). (For an account of the mating of *E. zonatus*, see under *Adult Habits*.)

In the following key I describe seven species, *jenkinsoni*, *obliquus*, *restrictus*, *arcanus*, *longifrons*, *obscurus* and *dissimilis* as new to science, bringing the total of our British *Eudorylas* to 23.

KEY TO SPECIES

1 No apical posteroventral spur present on four anterior tibiae ; all tibiae with at most base rather narrowly yellow ; stigma not extending back to tip of Sc. ♂ abdominal segment 8 with narrow, oblique apical membraneous area.....2



FIGS. 142–143.—*Eudorylas*, female ovipositor. 142, *halteratus* ; 143, *melanostolus*.

– Four anterior tibiae with a distinct posteroventral spur (fig. 141) at tip.....3

2 Stigma (fig. 139) not longer than following costal segment, subequal in ♂, shorter in ♀ ; base of all tibiae rather narrowly clear yellow, legs otherwise black ; smaller species ; wing length 3·5–4 mm. ♂ abdominal segment 8 rounded, gradually on left, more sharply on right, about half as long as tergite 5. ♀ ovipositor (fig. 142) with base moderately deep, squat, shorter than piercer, which is straight **halteratus** Meigen[3]

Lancs. (*Stowe Wood*), *H. Britten; Suffolk* (*Tuddenham Fen*), *G. H. Verrall; Bedford* (*Barton Hills*), *F. W. Edwards; Wilts.* (*Coombe Bissett and Wishford*), *C. H. Andrewes. vi–vii.* (See foot-note).

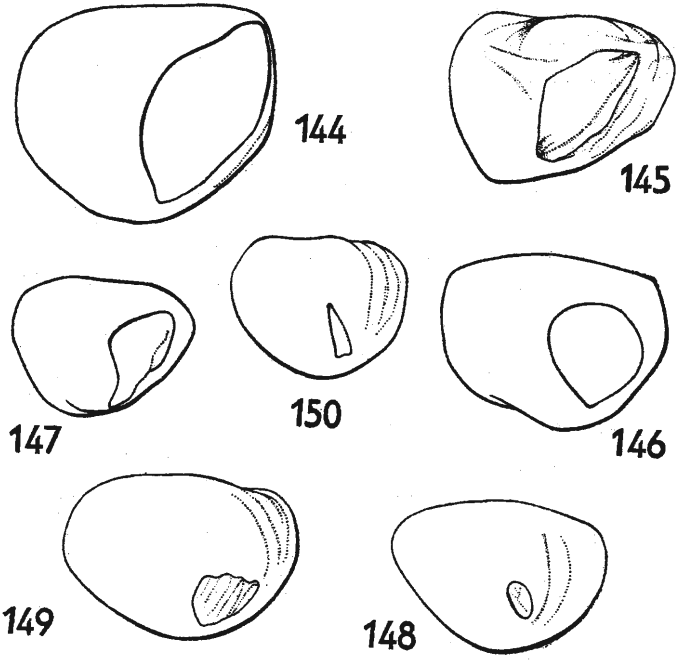
[3] *Eudorylas halteratus* Meigen. Verrall examined Meigen's types in Paris, but it appears that if he saw *halteratus* only an unidentifiable fragment remained. Verrall (1901: 96) states, "Meigen knew but one male (of *halteratus*), which he imperfectly described". Continental specimens identified as *halteratus* and examined by me agree with Verrall's interpretation of the species.

– Stigma (fig. 140) longer than following costal segment in ♂ (1¼ to 2 times as long), subequal in ♀ ; all tibiae with base obscurely yellowish, legs otherwise black ; large species ; wing length 5–5.5 mm. ♂ abdominal segment 8 closely resembling that of *halteratus* ♂. ♀ ovipositor (fig. 143) long, slim, piercer moderately upcurved towards body ..... **melanostolus** Becker

Herts. (Knebworth), F. W. Edwards; Essex (Epping Forest), ? collector; Berks., (Wytham), G. C. Varley; Hants. (New Forest), J. W. Yerbury; Surrey (Weybridge), C. J. Wainwright. v–vii.

3 Tergites evenly and abundantly clothed with strong, black, bristly hairs ; wing length 3·5–4·5 mm. ♂ viewed from behind, tergites 2–5 with broad black anterior bands contrasting with light grey ; segment 8 with rather large, long and narrow membraneous area ; a long curved dark proclinate bristle present anteriorly at middle of hind tibiae. ♀ viewed from behind, at least tergites 2 and 3 are darkened anteriorly ; ovipositor with base rather narrow, convex below with a protuberance above towards tip, and only half the length of piercer, which is very slightly upcurved towards body ..... **horridus** Becker

Warwick. (Burton Bassett), J. R. Vockeroth; Suffolk (Woodditton Wood), J. E. Collin; Gloucester. (Olveston), H. Audcent; Somerset (Clevedon), H. Audcent; Kent (Eynsford and Pegwell Bay), E. A. Fonseca; (Eynsford), R. L. Coe; Devon. (Newton Abbot), R. C. L. Perkins; Dorset (Portland and Kingston), C. H. Andrewes. vi–viii.



FIGS. 144–150.—*Eudorylas* ♂, abdominal segment 8, from behind. 144, *subfascipes* ; 145, *jenkinsoni* ; 146, *fascipes* ; 147, *obliquus* ; 148, *restrictus* ; 149, *terminalis* ; 150, *subterminalis*.

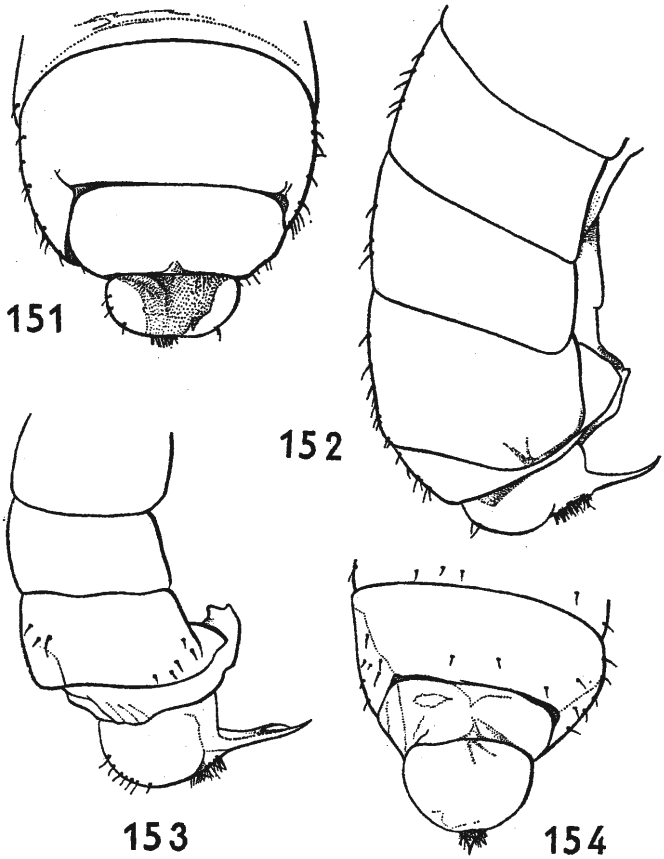
– Tergites sparsely clothed with weak, usually pale, hairs 4

4 All femora obviously yellow at base, hind pair usually more extensively so (but in *restricta* ♂ and *subterminalis* ♂ *the hind pair only* may be distinctly yellow at base) ; tibiae mainly or entirely yellow, at least above ; tarsi yellow, apart from last one or two segments darkened ; humeri distinctly yellow, contrasting with black or grey of occiput (except in *fascipes*, which has humeri variable in colour) 5

– All femora black or grey to actual base (the muscular area attaching femora to trochanters may be pale and immature specimens may have a restricted pale area at base, but in such cases the true black or grey coloration is apparent from some angles) ; tibiae often extensively darkened ; tarsi usually more or less so ; humeri light or dark 18

5 Males 6

– Females 12



FIGS. 151–154.—*Eudorylas*, female ovipositor (151, 154, base, from above ; 152, 153, from side). 151–152, *jenkinsoni* ; 153–154, *fascipes*.

6 Abdominal segment 8 (fig. 144) with a conspicuous large usually broad obviously excavated membraneous area to right of hind margin, extending almost or completely the depth of the segment 7

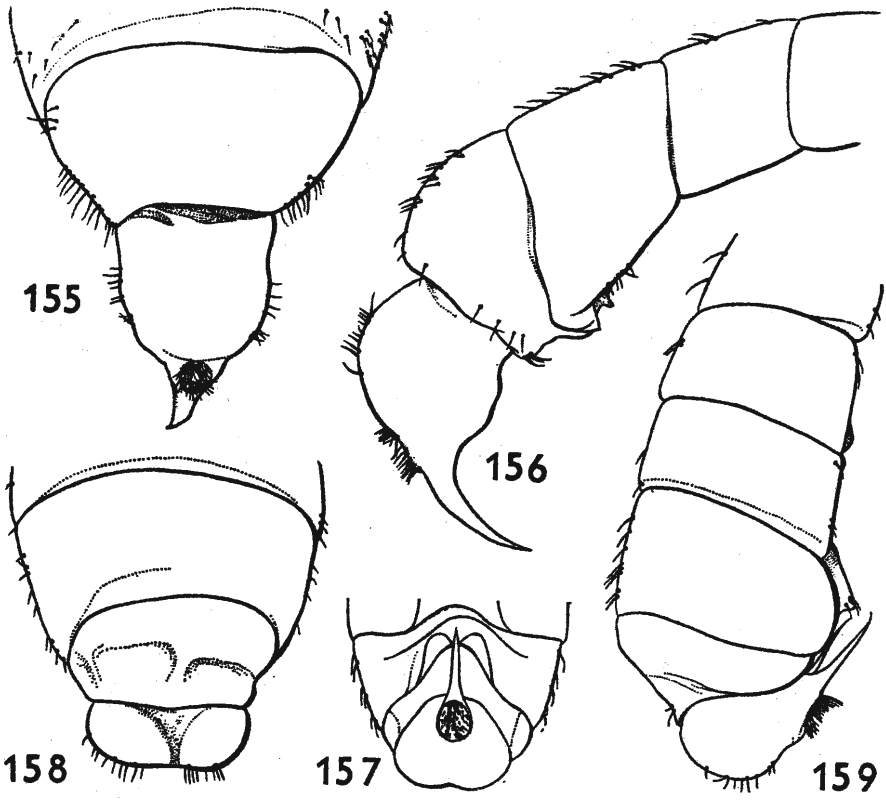
– Abdominal segment 8 (figs. 147–50) with an inconspicuous small (less so in *obliquus*) scarcely excavated membraneous area to right of hind margin 9

7 The membraneous area (fig. 144) extending absolutely from the highest extremity of segment 8 almost to the lowest, wide and very deeply excavated, narrowly angled at its highest extremity so that the segment is there somewhat pointed ; wing length 5–6 mm. . . **subfascipes** Collin (*fascipes* Verrall nec Zetterstedt) ♂
Inverness., Perth., Midlothian, Yorks., Cheshire, Derby., Cambridge., Suffolk, Gloucester., Oxford., Buckingham., Wilts., Berks., Surrey. ***iv–vi, viii.***

– The membraneous area (fig. 145) not extending up to the highest extremity of segment 8, although sometimes nearly so 8

8 Membraneous area (fig. 145) rather narrow, roughly triangular, rather shallowly excavated ; stigma quite long, longer than distance between discal and lower cross-vein ; antennae with third segment dark brownish, with long tapering whitish point ; larger species ; wing length 4·5–5·5 mm.....**jenkinsoni** sp. n. ♂

Holotype ♂ : *Moray.* (*Altyre*), 9.ix.1913, *F. Jenkinson.* Paratypes : *Moray.* (*Logie*), 12–29.ix.1910–1913, *F. Jenkinson*, 2 ♂ 6 ♀ ; *Banff.* (*Glen of Drumloch*), 16.viii.1937, *R. L. Coe*, 1 ♀ ; *N. Lancs.* (*Lake Coniston*), 8.ix.1955, *R. Underwood*, 1 ♂ ; *Surrey* (*Warlingham*), 5.viii.1954, *R. L. Coe*, 1 ♀. Other Material : *Berks.* (*Checkendon*), 3.vi.1964, *E. Burtt*, 1 ♂ ; *Sussex* (*Crowborough*), 9.vii.1910, *F. Jenkinson*, 1 ♂. *vi–ix.*



FIGS. 155–159.—*Eudorylas*, female ovipositor (155–157, showing anal opening ; 156, 159, from side ; 158, from above). 155–156, ? *kowarzi* ; 157–159, *subfascipes*.

Membraneous area (fig. 146) broader, more rounded, more deeply excavated ; stigma quite short, not longer than distance between discal and lower cross-vein ; antennae with third segment light brownish, with moderately long whitish point ; small species ; wing length 4–4·25 mm.....**fascipes** Zetterstedt ♂

Inverness., Northumberland, Durham, Lancs., Norfolk, Radnor., Huntingdon., Surrey, Kent, Dorset, Sussex. Ireland, County Leitrim (*Drumsillagh*). *vi–vii.*

9 Viewed from behind, abdominal segment 8 is almost evenly rounded, *i.e.* it is not at all truncate to the right of the very small inconspicuous membraneous area..10

– Viewed from behind, abdominal segment 8 (fig. 147) immediately to the right of the rather inconspicuous almost vertical membraneous area is obliquely truncate

from right to left, so that the right-hand lower section appears to be lopped off ; body from above greyish-brown, but from behind all tergites anteriorly with broad dark brown or brownish-black bands, light grey posteriorly ; wings with last section of M_{1+2} appreciably undulating, distinctly concave behind on apical two-thirds ; normally larger species than *terminalis* or *subterminalis* ; wing length 4–4·5 mm. ..... **obliquus** sp. n. ♂

Holotype ♂ : *Kent* (*Deal*), 13.vi.1959, *R. L. Coe*. Paratypes : *Oxford.* (*Goring Heath*), 19.ix.1964, *E. Burtt*, 1 ♂ ; *Hereford.* (*Haugh Wood*), 12.ix.1903, *J. H. Wood*, 1 ♂ ; *Hants.* (*New Forest*), 27.ix–7.x.1903, *D. Sharp*, 1 ♀ ; *Surrey* (*Addington*), 14.ix.1959, *R. L. Coe*, 4 ♂. *Ireland, County Wicklow* (*The Murrough, Killoughter*), 11.vi.1953, *R. L. Coe*, 6 ♂. Other Material : *Cambridge., Hereford., Middlesex, Hants., Surrey, E. Kent. vi–x.*

10 From above, thorax and scutellum blackish-grey, tergites brownish-grey ; abdominal segment 8 (fig. 148) nearly as broad as tergite 5, obviously much wider than deep (but less wide than in *terminalis* ♂) ; larger species ; wing length 4·5–5·0 mm. ..... **restrictus** sp. n. ♂ (♀ unknown)

Holotype ♂ : *Hereford* (*Cowburrough Park*), 29.vii.1901, *J. H. Wood*. Paratypes : 4 ♂, same data as holotype.

— Body light or dark chocolate-brown, and greyish ; smaller species 11

11 Abdominal segment 8 (fig. 149) at least almost as broad as tergite 5, viewed from behind much wider than deep ; ? occiput very shallow (see remarks below) ; wing length 4·25 mm. (only two examples seen) ..... **terminalis** Thomson ♂

Inverness. (*Aviemore*), 24.vi.1933, *R. L. Coe*, 1 ♂ ; (*Grantown*), 27.vi.1959, *C. H. Andrewes*, 1 ♂. (The head of the Aviemore example has obviously been stuck on, hence the occiputal character may be misleading ; the Grantown example is headless).

— Abdominal segment 8 (fig. 150) considerably narrower than tergite 5, viewed from behind not much wider than deep ; occiput considerably swollen, especially above ; wing length 4–5 mm.

subterminalis Collin (*terminalis* Verrall nec Thomson) ♂

Cumberland, Yorks., N. Lancs., Cheshire, Stafford., Cambridge., Hereford., Huntingdon., Oxford., Buckingham., Glamorgan., Wilts., Berks., Middlesex, Hants., Surrey, Kent, Sussex. v–viii, x.

12 Viewed from above, base of ovipositor (fig. 151) with a remarkably broad and deep excavation occupying quite median third of dorsal surface ; anal opening small, inconspicuous, oval ; piercer (fig. 152) short, very slightly curved towards body, slightly longer than base. (Wing length, distribution and dates, see ♂)

jenkinsoni sp. n. ♀

— Base of ovipositor with at most a longitudinal groove, not nearly occupying median third of dorsal surface 13

13 Base of ovipositor without a longitudinal groove dorsally ; frons entirely grey ; third antennal segment yellowish-orange ; body greyish-brown ; all femora yellow-tipped, at least hind pair distinctly so at base ; tibiae clear yellow, sometimes vaguely obscured about middle 14

— Base of ovipositor with a longitudinal groove dorsally 15

14 Ovipositor (figs. 153, 154) with base small, distinctly wider than long ; piercer very short, only slightly longer than base, fine, straight ; anal opening small, oval ; tarsi clear yellow, except last segment darkened ; smaller species. (Wing length, distribution and dates, see ♂) ..... **fascipes** Zetterstedt ♀

— Ovipositor (figs. 155, 156) with base rather large, distinctly longer than wide ; piercer obviously longer than base, thick, strongly upcurved throughout ; anal opening (fig. 155) large, roundish ; tarsi inclined to be obscured above, last segment blackish ; larger species ; wing length 5·25–6 mm.

? kowarzi Becker ♀ (♂ not recorded in Britain)

Warwick. (*Waverley Wood*), 10.vi.1953, *H. Britten*, 1 ♀ ; *Suffolk* (*Ipswich*), 27.vi.1899, *C. Morley*, 1 ♀ ; *Herts.* (*Bricket Wood*), 22.vi.1947, *L. Parmenter* and *C. N. Colyer*, 2 ♀.

15 Anal opening (fig. 157) large, conspicuous, broad, very shortly oval ; viewed from above the base of ovipositor (fig. 158) is much wider than long, *only shallowly indented behind at middle, the median groove indistinct and narrow;* piercer (fig. 159) distinctly longer than base, the extreme tip slightly curved up towards body. (Wing length, distribution and dates, see ♂)

subfascipes Collin (*fascipes* Verrall nec Zetterstedt) ♀

— Anal opening (fig. 162) small, inconspicuous, roundish or oval ; viewed from above, the base of ovipositor (figs. 160, 163, 164) is more or less distinctly indented behind, *the median groove deeply impressed and rather wide;* piercer (figs. 161, 162, 165) distinctly longer than base ; smaller species.....16

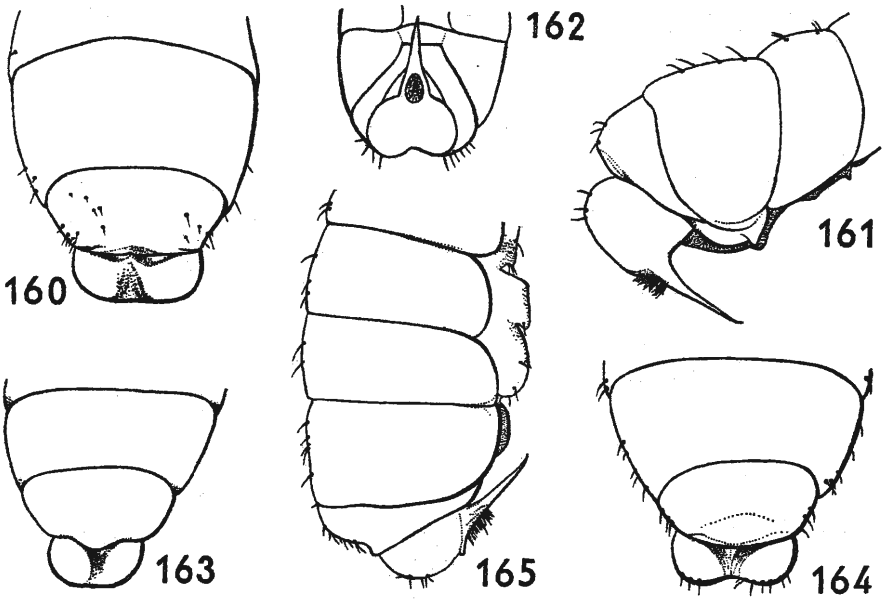
16 The lobes of base of ovipositor (figs. 163, 164) are equal or subequal.....17

— The lobes of base of ovipositor (fig. 160) are unequal, the left lobe being smaller ; the base is short and moderately broad ; piercer (fig. 161) almost straight ; anal opening (fig. 162). (Wing length, distribution and dates, see ♂)

obliquus sp. n. ♀

17 Viewed from above, the base of ovipositor (fig. 163) is longer and narrower than in *subterminalis* ♀, occupying less than three-quarters of width at base of segment 6 (no examples seen by me, latter comparison made from Collin's text and figure in *Opusc. Ent.* **21** 1956). Wing length, distribution and dates, see ♂)

terminalis Thomson ♀



FIGS. 160–165.—*Eudorylas*, female ovipositor (160, 163, 164, base, from above ; 161, 165, from side ; 162, showing anal opening). 160–162, *obliquus* ; 163, *terminalis* (after Collin 1956) ; 164–165, *subterminalis*.

— Viewed from above, the base of ovipositor (fig. 164) is short and broad, occupying more than three-quarters of width at base of segment 6 ; piercer (fig. 165) very slightly recurved at extreme tip ; tibiae and tarsi more distinctly yellowish than in *terminalis* ♀. (Wing length, distribution and dates, see ♂)

subterminalis Collin (*terminalis* Verrall nec Thomson) ♀

18 ♂ abdominal segment 8 (fig. 166) greatly enlarged, with no distinguishable apical membraneous area ; tergites 2–4 very short, together scarcely, if at all, longer than tergite 5 and segment 8 together. ♀ ovipositor (fig. 181) with the base fitting exactly into a cavity, so that viewed from the side it is flush with the outline of segment 6 ; base small, roundish, smooth. ♂♀ body light greyish-brown ; wing length 3·25–4 mm. (3 examples seen).....**ruralis** Meigen

Hants. (*New Forest*), 29.viii–9.ix, 1901, *D. Sharp*, 1 ♂ 1 ♀ ; *Sussex* (*Blackboys*), 15.vii.1876, *G. H. Verrall*, 1 ♂.

— ♂ abdominal segment 8 not enlarged, at maximum length not longer than tergite 5; tergites 2–4 of normal length, together considerably longer than tergite 5 and segment 8 together. ♀ ovipositor with base not fitting exactly into a cavity, so

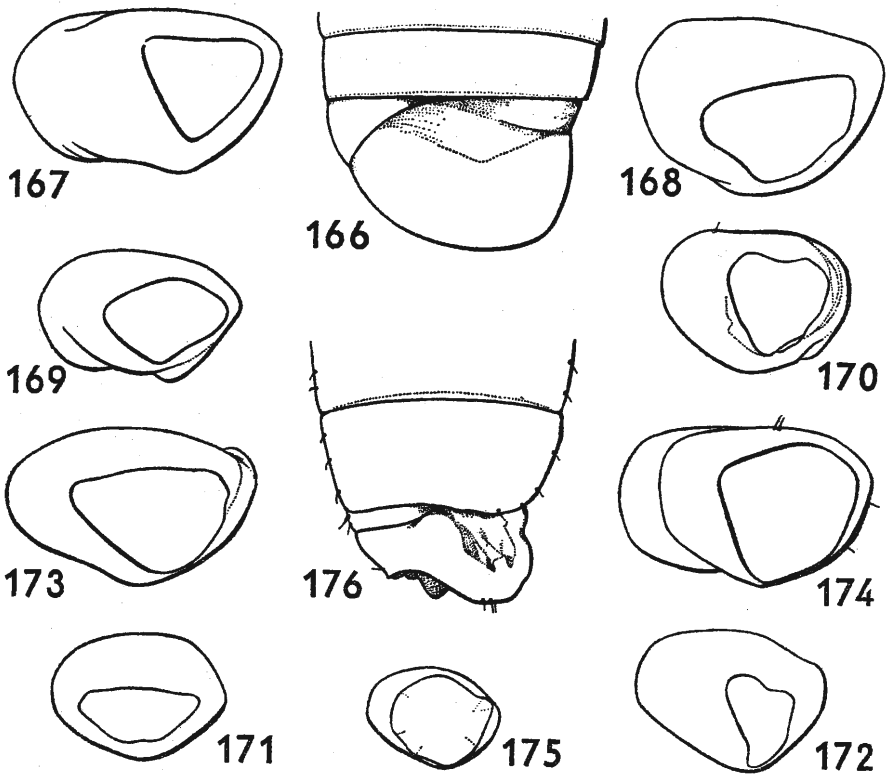
that viewed from the side it protrudes obviously from the outline of segment 6 ; base sometimes with a median longitudinal groove, or bilobed.....19

19 Humeri distinctly yellowish, contrasting with black or grey of occiput.....20

— Humeri grey, brown or blackish, as dark as or darker than occiput.....25

20 All tibiae entirely clear yellow dorsally, or at most vaguely darkened for slightly more than apical half ; at least front and mid metatarsi and usually three following segments clear yellow. ♀ ovipositor small, base with a deep longitudinal median groove, piercer straight.....21

— All tibiae black, at least dorsally, for apical half and usually more extensively so ; tarsi more or less extensively darkened.....22



FIGS. 166–176.—*Eudorylas* ♂, abdominal segment 8 (166, 176, from above ; remainder from behind). 166, *ruralis* ; 167, *arcanus* ; 168, *longifrons* ; 169, *zermattensis* ; 170, *obscurus* 171, *unicolor* ; 172, *montium* ; 173, *zonatus* ; 174, *inferus* ; 175–176, *fuscipes*.

21 ♂ frons not longer than third antennal segment ; abdominal segment 8 (fig. 167) rather short and wide, gradually rounded on the left and somewhat angled on the right, the shining blackish ground colour more or less obscured from various angles by brownish-yellow dusting ; the membraneous area quite large, roughly triangular, absolutely posteriorly directed ; body brownish-black. ♀ third antennal segment clear yellow, with long pointed whitish tip ; ovipositor (fig. 189) ♂ ♀ stigma short ; small species ; wing length 4–5 mm.....**arcanus** sp. n.

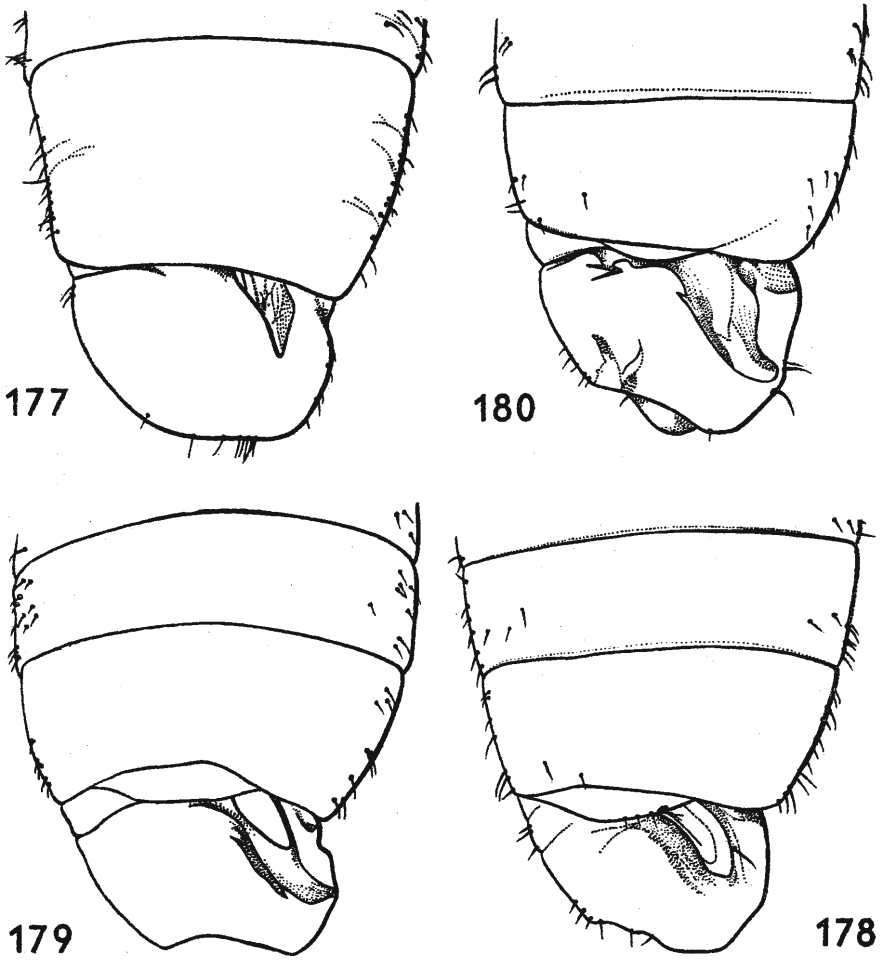
Holotype ♂ ; *Suffolk* (*Worlington*), 17.v.1945, *J. E. Collin*. Paratypes : 1 ♀, same data as holotype ; *Hereford.* (*Doward*), 14.vii.1900, *J. H. Wood*, 1 ♀ ; *Dorset* (*Kingston*), 15.vi.1960, *C. H. Andrewes*, 2 ♀ ; *Sussex* (*Crowborough*), 9.viii.1912, *F. Jenkinson*, 1 ♀.

— ♂ frons obviously longer than third antennal segment ; abdominal segment 8 (fig. 168) with apical membraneous area large, slightly posteroventrally inclined ; third antennal segment blackish ; body brownish. ♀ third antennal segment pale brownish with whitish tip ; ovipositor resembling that of *arcanus* ♀. ♂♀ stigma long ; larger species ; wing length 4·25–5·5 mm.....**longifrons** sp. n.
Holotype ♂ : *Hants.* (*King's Somborne*). 7.viii.1929, *H. Audcent.* Paratypes : *Cambridge.* (*Cambridge*), 16.vii.1907, *F. Jenkinson*, 1 ♀ ; *Hereford.*, 8.vii.1898, *J. H. Wood*, 1 ♂ ; *Oxford.* (*Yarnton*), 29.vii.1927, *? C. G. Nurse*, 1 ♂ ; *Surrey* (*Warlingham*), 5.viii.1954, *R. L. Coe*, 1 ♀ ; *Devon'* (*Shaldon*), 17.vii.1904, *C. J. Wainwright*, 1 ♂ ; *Dorset* (*Swanage*), 20.vi.1960, *C. H. Andrewes*, 1 ♀. Other Material : *Suffolk, Hereford., Herts., Berks., and Dorset.*

22 Males 23

— Females 24

23 Viewed obliquely from behind, tergites and scutellum are shining blackish, latter without obvious dusting from this viewpoint ; abdominal segment 8 (fig. 169)

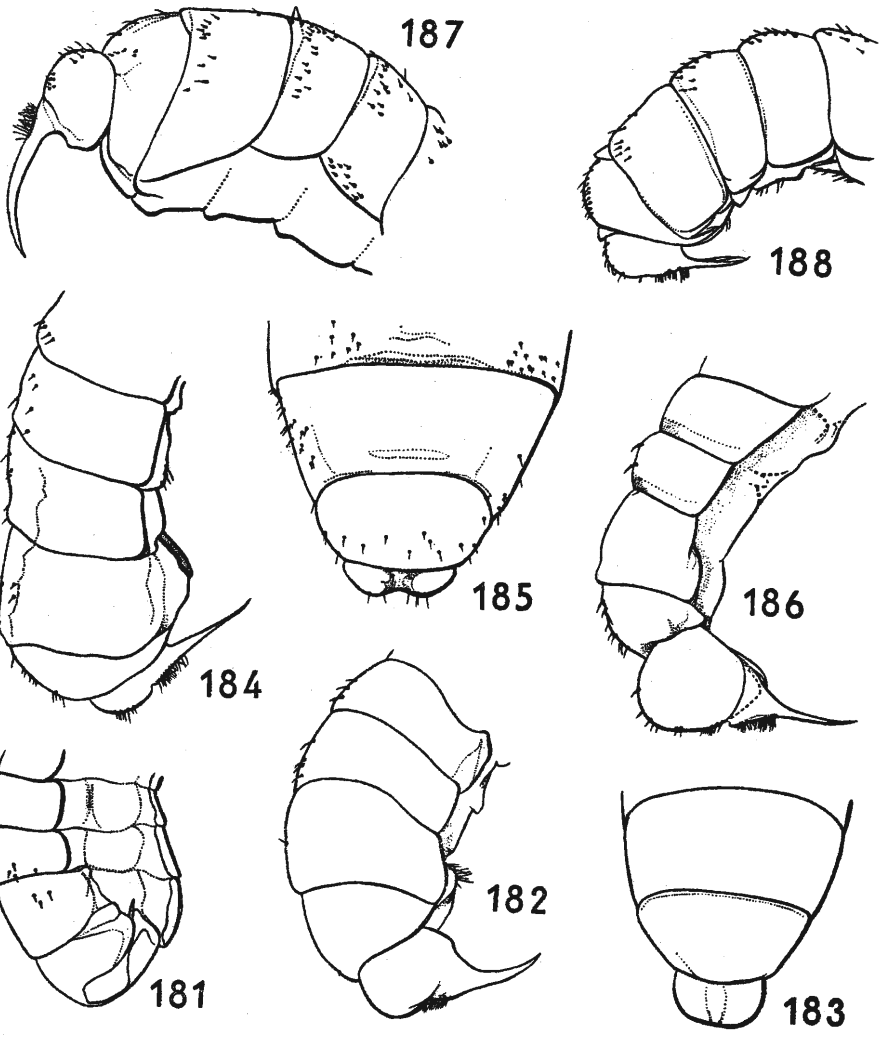


FIGS. 177–180.—*Eudorylas* ♂, abdominal segment 8, from above. 177, *dissimilis* ; 178, *zonatus* ; 179, *inferus* ; 180, *zonellus*.

with the membraneous area rather large ; small species ; wing length 3–3.5 mm. **zermattensis** Becker ♂

Cambridge. (*Six Mile Bottom*), 12.vii.1903, *F. Jenkinson*, 1 ♂ ; *Suffolk* (*Worlington*), 1.viii.1934, *J. E. Collin*, 1 ♂, 1 ♀ ; (*Freckenham*), 13.ix.1903, *C. Morley*, 1 ♂ ; *N. Somerset* (*Merrow*), 10.vi.1950, *E. A. Fonseca*, 1 ♂.

— Viewed obliquely from behind, tergites are dull greyish-, blackish- or chocolate-brown on disc, becoming pale grey towards sides ; scutellum blackish, obscured evenly with brown or greyish-brown dust from that viewpoint ; abdominal segment 8 (fig. 170) with the membraneous area more posteriorly, less ventrally, directed than in *zermattensis* ♂ ; normally rather large species ; wing length 4–5 mm. **obscurus** sp. n. ♂



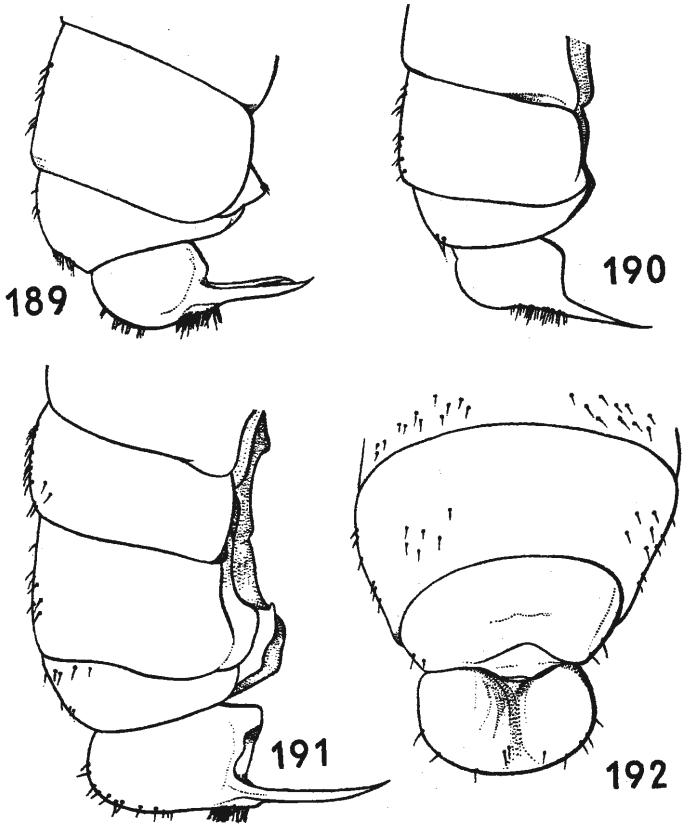
FIGS. 181–188.—*Eudorylas*, female ovipositor (181, from below ; 182, 184, 186–188, from side ; 183, 185, base, from above). 181, *ruralis* ; 182–183, *zermattensis* ; 184–185, *obscurus* ; 186, *fuscipes* ; 187, *zonatus* ; 188, *inferus*.

Holotype ♂ : *Surrey* (*Warlingham*), 5.viii.1954, *R. L. Coe*. Paratypes : same data as holotype, 1 ♂, 2 ♀ ; *Cambridge.*, (*Cambridge*), 30.vi.1912, *F. Jenkinson*, 2 ♂ ; *Hunts.* (*Wood Walton*), 16.vi.1923, *F. W. Edwards*, 1 ♀ ; *Gloucester.* (*Charlton*), 6.v.1953, 1 ♂, *and* (*Filton*), 19.vii.1948, *E. A. Fonseca*, 1 ♀ ; (*Rodborough*), 11.v.1944, *T. Bainbrigge-Fletcher*, 1 ♀ ; *Herts.* (*Ayot Green*), 15.v.1949, *C. N. Colyer*, 1 ♂, 1 ♀ in cop. ; (*Lilley Hoo*), 22.vii.1934, *F. W. Edwards*, 1 ♀ ; *Middlesex* (*Boston Manor*), 15.vii.1938, *A. M. Low*, 2 ♂. Other Material : *Moray.*, *Dumbarton.*, *Cambridge.*, *Gloucester.*, *Oxford.*, *Suffolk*, *Hereford.*, *Surrey*, *Sussex. v–ix.*

24 Viewed from above, thorax, scutellum and tergites are shining black ; occiput shining black, scarcely dusted on upper part ; ovipositor (figs. 182, 183) with base shining black, short and bulbous, without an obvious median longitudinal groove, shorter than piercer, which is moderately upcurved and rather slender after middle. (Wing length, distribution and dates, see ♂)
zermattensis Becker ♀

— From all viewpoints, thorax, scutellum and tergites are dull brownish-grey ; occiput completely dulled by dust, that on upper part being brownish-grey ; ovipositor (figs. 184, 185) with base dull and grey-dusted on at least basal part, short, somewhat flattish below, with a deep median longitudinal groove, and shorter than piercer, which is straight and rather slender. (Wing length, distribution and dates, see ♂).....**obscurus** sp. n. ♀

25 Males 26



FIGS. 189–192.—*Eudorylas*, female ovipositor (189–191, from side ; 192, base, from above). 189, *arcanus* ; 190, *montium* ; 191–192, *zonellus*.

— **Females** 32

26 No apical membraneous area present on abdominal segment 8 (fig. 177), which is short and of even length, gradually rounded on left and more suddenly on right; dorsally towards the right there is a narrow cleft, and posteroventrally there is a median depression of the chitin ; the segment is slightly shining, with the rather sparse yellowish-white dusting becoming more dense at apex ; thorax and scutellum chocolate-brown, abdomen rather lighter brown from some angles, the extensive sublateral grey markings spreading across quite four-fifths of disc of tergites posteriorly ; femora black, quite narrowly yellow-tipped, tibiae extensively yellow, more or less obscured after middle, tarsi extensively obscured. Wings with stigma complete, much longer than next costal section, last section of M_{1+2} almost straight. Wing length 5·5 mm... **dissimilis** sp. n. ♂ (♀ unknown)

Holotype ♂ : *Kent* (*Blean Woods*), 2.vii.1965, *L. Parmenter*.

— Apical membraneous area present on abdominal segment 8 27

27 Apical membraneous area (figs. 171, 172) noticeably small ; roundish or subtriangular 28

— Apical membraneous area (figs. 175, 178, 179) large 29

28 Viewed directly from behind, tergites 2–4 appear narrowly black anteriorly, with brownish-grey posterior bands, these becoming increasingly wider on succeeding tergites ; tergite 5 completely dark brownish-grey, apart from a large light grey spot at each posterior corner ; membraneous area of segment 8 (fig. 171) ventrally directed ; viewed from in front the frons are black, and nearly twice as long as third antennal segment ; legs black apart from narrowly yellowish knees, and tarsi sometimes partly yellowish ; wing length 4 mm. (three examples).

unicolor Zetterstedt ♂ (♀ not seen)[4]

Yorks. (*Allerthorpe*), vi, *? collector*, 1 ♂ ; *Hereford.* (*Doward*), 15.v.1912, *J. H. Wood*, 1 ♂ ; *Hants.* (*New Forest*), vii.1904, *D. Sharp*, 1 ♂ ; *Kent* (*Tunbridge Wells*), vii.1926, *C. G. Nurse*, 1 ♂

— Viewed directly from behind, tergites 2–5 appear black with contrasting light grey side-markings, extending posteriorly over at least two-thirds of dorsum ; membraneous area (fig. 172) posteroventrally directed ; viewed from in front, the frons are grey, scarcely longer than third antennal segment ; femora yellow-tipped, tibiae yellow for at least basal third, tarsi sometimes more or less extensively yellowish ; wing length 4–5 mm..... **montium** Becker ♂

Widely distributed in Scottish Highlands; Midlothian (*Edinburgh, Coniston sand quarry*), 10.vi.1921, *W.E.* (*sic*), 1 ♂ ; *Lancs.* (*Heston Norris*), 25.vii.1951, *W. D. Hincks*, 1 ♂ ; *Shropshire* (*Whixall Moss*), *? date, collector and sex; Hereford.* (*West Hide*), 9.vii.1899, *C. J. Wainwright*, 1 ♂. *vi–vii.*

29 Membraneous area of segment 8 almost ventrally directed 30

— Membraneous area of segment 8 posteriorly or posteroventrally directed..... 31

30 Viewed obliquely from behind, the light grey side-markings on tergites 2–5 only occupying about posterior half of tergites sublaterally, the remainder being contrasting brownish-grey or darker ; viewed from above, segment 8 (figs. 173, 178) is considerably more extended backwards on the right than on the left, the posterior margin not at all parallel to that of tergite 5 ; the apical membraneous area (fig. 178) is usually less elongate than in *inferus* ♂ ; wing length 5–5·25 mm.

zonatus Zetterstedt (*distinctus* Becker) ♂

Stafford., Norfolk, Worcester., Cambridge., Oxford., Buckingham., Wilts., Berks., Middlesex, Hants., Surrey, Kent, Devon., Dorset, Sussex. Ireland. vi–viii.

— Viewed obliquely from behind, the light grey side-markings on tergites 3–5 occupying at least posterior two-thirds of tergites sublaterally, the remainder being contrastingly brownish-grey or darker, while tergite 2 is entirely light grey sublaterally ; viewed from above, segment 8 (figs. 174, 179) is only slightly more extended backwards on the right than on the left, the posterior margin almost parallel to that of tergite 5 ; the apical membraneous area (fig. 179) is inclined to be more elongate and more angular than in *zonatus* ♂ ; wing length 4–6 mm.

inferus Collin ♂

Shropshire (*Grinshill*), vii.1903, *C. G. Lamb*, 2 ♂ ; *Cambridge.* (*Cambridge*), 4.vii.1920, *F. Jenkinson*, 1 ♂ ; *Suffolk* (*Barton Mills*), vii.1930 and 10–16.vi.1948, *J. E. Collin*, 3 ♂ ; *Hereford.* (*Stoke Wood*), 29.v.1912, *J. H. Wood*, 1 ♂ ; *Hants.* (*New Forest*), v–vii, *various collectors*, ♂♂, ♀♀ ; *Surrey* (*Warlingham*), 20.v.1954, *R. L. Coe*, 1 ♂ ; *Kent* (*Sevenoaks*), 4.vii.1965, *L. Parmenter*, 1 ♂. *v–vii.*

[4] *Eudorylas unicolor* Zetterstedt. I have not seen a female example of *unicolor*, and have therefore omitted that sex in my key, as in this obscure group I prefer not to quote from other authors' descriptions.

31 Abdominal segment 8 (figs. 175, 176) is rather small, and viewed from above is slightly rounded on left portion, then more or less abruptly projecting on right portion ; the apical membraneous area (fig. 175) is very large, deep and roundish ; viewed from behind, the light grey posterior markings on tergites 2–4 do not spread over lateral two-thirds of dorsum ; small species ; wing length 3·25–4 mm.
fuscipes Zetterstedt ♂
Widely distributed, Perth. and southwards. Ireland, County Dublin (Howth); County Kildare (Naas). v–ix.

— Segment 8 (fig. 180) is of moderate size and viewed from above is rounded along entire posterior margin, gradually so on the left and sharply so on the right portion, which only slightly projects ; the apical membraneous area is rather oval or roundish in shape and extends the full depth of the segment as in *fuscipes* ♂ ; viewed from behind, the light grey posterior markings on tergites 2–4 are seen spreading distinctly over lateral two-thirds of dorsum, only median third of dorsum remaining entirely brownish-black ; rather large species ; wing (fig. 23) ; wing length 4–6 mm.
zonellus Collin (*zonatus* Kowarz and Verrall, nec Zetterstedt) ♂
Cheshire, Stafford., Norfolk, Warwick., Cambridge., Suffolk, Hereford., Huntingdon., Bedford., Gloucester., Oxford., Buckingham., Glamorgan., Essex., Wilts., Berks., Somerset, Hants, Surrey, Kent, S. Devon., Sussex. v–viii.

32 Base of ovipositor (figs. 186, 190) not obviously projecting on upper part at tip, although this part is swollen and often yellowish ; piercer almost straight....33

— Base of ovipositor (figs. 187, 191) projecting (and more or less swollen) on upper part at tip, this projection usually yellowish.....34

33 Base (fig. 186) of moderate size, appearing nearly globular from behind, rather wide; small species. (Wing length, distribution and dates, see ♂)
fuscipes Zetterstedt ♀

— Base (fig. 190) small, only slightly convex below, appearing more or less semi-globular from behind, narrow ; normally larger species than *fuscipes*. (Wing length, distribution and dates, see ♂).....**montium** Becker ♀

34 The yellow protuberance of base of ovipositor (fig. 191) prominent and rounded; base small, quite wide, with deep median groove ; the piercer at most only slightly upcurved, and moderately longer than the base ; scutellum heavily light grey-dusted on disc, so that even from behind it is not or scarcely shining ; rather large species. (Wing, length distribution and dates, see ♂)
zonellus Collin (*zonatus* Kowarz and Verrall, nec Zetterstedt) ♀

— The yellow protuberance truncate (fig. 187).....35

35 Piercer (fig. 187) strongly upcurved, nearly twice as long as the base, which is small and rather narrow ; scutellum only thinly grey-dusted, and viewed from behind moderately shining with the blackish ground colour exposed ; normally rather large species. (Wing length, distribution and dates, see ♂)
zonatus Zetterstedt (*distinctus* Becker) ♀

— Piercer (fig. 188) only slightly upcurved, slightly longer than the base, which is small and narrow ; scutellum rather heavily grey-dusted on disc, and viewed from behind not or only slightly shining ; normally rather large species. (Wing length, distribution and dates, see ♂).....**inferus** Collin ♀

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