BIBIONID AND SCATOPSID FLIES

DIPTERA: BIBIONIDAE & SCATOPSIDAE

By

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Contents

Abstract

The relationship of the two families Bibionidae and Scatopsidae is discussed and for each, accounts are given of their structure, life histories and economic importance, followed by details of methods of collection and examination and revised check lists. Keys are presented to the two genera and 20 species of Bibionidae known from Britain. For the Scatopsidae, keys are given to the four subfamilies, three of which contain only one British genus, and to the three tribes of the fourth subfamily, the Scatopsinae, and to their included genera; altogether 15 genera and 37 species of this family are recognized as British.

In the Bibionidae, a new species *Bibio edwardsi* Freeman & Lane is described and *B. hybridus* Haliday is raised from varietal rank to be treated once again as a full species. In the Scatopsidae, a new species *Rhexosa richardsi* Freeman, is described, and a new genus *Cookella* Freeman proposed for *Scatopse albitarsis* Zetterstedt, formerly placed in *Holoplagia. Ferneiella* is described as a new genus by E.F. Cook, with *Scatopse incompleta* Verrall as type species.

The families Bibionidae and Scatopsidae: general introduction

The flies placed in these two small Nematocerous families are all thick-set, with short thick antennae and not dissimilar venation. Their general appearance is not particularly typical of the Nematocera, so it is not surprising that historically they have been treated together, even though there are many differences.

Although several species in both families are quite common and often abundant, they do not have well-recognized English vernacular names. In America, bibionids are known as "March flies", but this is hardly appropriate in Britain where most appear in mid-April at the earliest. Simple translations of the Latin names have produced "St Mark's fly" for *Bibio marci,* from its time of appearance around St Mark's Day, 25th April, and "fever fly" for *Dilophus febrilis,* a species, which in Sweden was thought, erroneously, to swarm around the houses of fever-stricken people. There are no common names at all for Scatopsidae.

Some bibionids are rather large, stout, blackish and hairy, and are frequently conspicuous for a few weeks, mainly in spring. They can readily be observed and collected, as they tend to be sluggish or to keep together in dancing swarms in bright sunshine. Scatopsids are much smaller and barer, but often very numerous; they are best searched for on flowers, especially umbels and ivy; they are not a particularly prominent element in the fauna as a rule, although mass emergence of thousands of these tiny flies in early summer or autumn may make them conspicuous for a short time on leaves, fences and so on.

Before 1912, the Scatopsidae were treated simply as a subfamily of the Bibionidae, as they still are in Richards & Davies (1977). 1912 was the year in which Enderlein published his revision of the group, raising it to full family rank, a condition almost universally accepted by Dipterists ever since. Edwards (1925) in his synopsis of the British species of the two families, gave the main features separating them, showing that there are probably as many differences as similarities between the two. Despite these differences, the strange similarity between the front tibiae of *Aspistes* (Scatopsidae) and those of the genus *Bibio,* may indicate that the families are indeed sister groups. It is therefore quite logical for this Handbook to cover both families, thus maintaining the historical link.

The key given by Oldroyd (1970a) in the introductory part of the Diptera section of this Handbooks series, enables the families to be separated, both from each other and from other Nematocera. The following table indicates the main differences.

Table 1

Bibionidae	Scatopsidae
Eyes not kidney-shaped; of male holoptic and each divided into two parts; of female widely separated	Eyes kidney-shaped in both sexes, in almost all species meeting above antennae, not divided in either sex
Antennae arising close to oral margin	Antennae far removed from oral margin
Palpi long and five-segmented	Palpi with only one, large, segment
Tibiae with well-formed spurs, large pulvilli present	True tibial spurs absent, pulvilli absent or very small
Cross-vein m-cu present	Cross-vein m-cu absent
Abdominal pleura not pleated	Abdominal pleura always pleated
Female with three spermathecae	Only one spermatheca present
Male genitalia simple and never rotated	Male genitalia complex and often rotated through 180°
Often very hairy	General appearance bare
Larva caterpillar-like, though legless, spiracles sessile	Larva more flattened, spiracles on processes in known species

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Family Bibionidae

by Paul Freeman and Richard P. Lane

Introduction

Many bibionids are conspicuous, hairy, black flies, especially the males, which often perform an up-and-down dancing flight in bright sunshine. *Bibio marci,* the so-called St Mark's fly, is one of the largest species and, as mentioned in the general introduction, derives its name from its flight period; another large species *Bibio pomonae* is known by the local name "heather fly". One of the smaller species, *Dilophus febrilis,* is very common and as previously mentioned is sometimes called by the not very appropriate name "fever fly" — a direct translation of the Latin name; it is also known as the "blossom fly". The larvae of all 20 British species of Bibionidae feed on roots and decaying organic matter in the soil and the adults of some play a part in fertilisation of fruit tree blossom. The larvae can be of economic importance because they feed gregariously at the roots of grasses and various agricultural crops and seedlings. They may cause slight or quite considerable damage, sometimes spreading over entire fields. Both adults and larvae are a source of food for birds, especially ground-feeding species, such as pheasants and partridges.

On a worldwide basis it is now usual to divide the Bibionidae into three subfamilies, only one of which, the Bibioninae, occurs in Britain. Two genera are British, *Bibio* with 16 species and *Dilophus* with four; the latter is more abundant in warmer countries. The information given in this Handbook applies only to the British genera, to expand it to cover the other subfamilies would be too confusing for our restricted fauna.

Adult structure

As mentioned above, this Section applies only to the British fauna with its two genera in the subfamily Bibioninae. We are following the terminology given by Hardy (1981).

Head (figs 1-5). Shows strong sexual dimorphism. The compound eyes of the male are very large and holoptic, occupying most of the upper surface of the head; each is divided into a larger upper portion with bigger facets and a smaller lower part with smaller facets. Those of the female are comparatively small and dichoptic, though still well developed; they are not divided in this sex. There are three ocelli set on a dorsal prominence. The antennae are inserted below the eyes, close to the oral margin, their segments are short, stout and closely set so that the whole antenna is short and thick. Antennal segmentation is sometimes useful in species definition and consists of a basal scape and pedicel followed by a flagellum of 5-11 segments. It is now usual to consider the flagellum to be a single primitive segment that has become subdivided, so for uniformity we are using only the segmentation of the flagellum and omitting mention of scape and pedicel. Great care is needed in the examination of the segmentation as the apical two segments are often indistinctly separated and their condition may vary in the same species; the apical segment is sometimes very small and easily overlooked, so that the antennae should be slide mounted in cases of doubt (figs 27 and 28 are both drawn from slides). The mouth parts have conspicuous, long maxillary palpi, often longer than the antennae; each has five segments, the basal segment being small, about as wide as long, resembling an enlarged palpifer, followed by four much longer, more or less equal segments, the size of which may be of specific importance. The mouthparts themselves are protrusible on the membranous connection to the head capsule and are quite simple

structure. The whole head is very hairy in males, with plentiful long hairs beneath and long interfacetal hairs on the eyes, varying in length in different species; female heads are less hairy, depending on the species, the interfacetal hairs sometimes quite short or practically absent.

Thorax (figs 1, 2). Dorsally the thorax is often shining black and clothed with long hairs which spread to the pleura; frequently the areas of indirect muscle attachment on notum are wrinkled or dull according to the species and hairs may be shorter, dark or pale or confined on notum to lines of dorso-central and lateral hairs. Pronotum distinct, large in *Dilophus* (figs 2, 4) which also has two transverse rows of short spines. There are no taxonomically useful hair patches on the pleura, but the length, density and colour of the general thoracic hair is often useful. Scutellum small and rounded, postnotum not conspicuous. There is sometimes a strong sexual difference in thorax colour, with the females reddish and the males black.

Legs (figs 1, 2, 20-26, 31-39). These are a characteristic feature of the family. The front pair are used for digging, both out of the soil at eclosion and into it for egg-laying. The front coxae and femora are swollen and hairy, whilst the tibiae are short, frequently swollen, with a strong apical spine and spur in *Bibio* and circlets of 7-9 strong spines in *Dilophus* which has extra spines midway as well. The other legs are more normal but rather long and sturdy, especially the hind legs of the male. All tarsi are unmodified but strong and well developed with large pad-like pulvilli and empodium, much the same length as the claws; all legs are well clothed with strong spiny hairs; strong tibial spurs are present on at least the four posterior legs and these are sometimes flattened. Proportions and degree of swelling of the various leg segments are useful specific characters as are the arrangement and size of spurs and spines on the tibiae.

Wings (figs 1, 14, 15). These are rather broad and may be milky-white, colourless, blackish or with brownish suffusions especially in the females. The anterior veins (costa and radius) are usually, but not always, darker than the posterior veins (media and cubitus). Costa and radius bear macrotrichia but these are absent from all other veins and from the membrane, the latter being densely clothed with microtrichia. There is usually a dark, oval stigma around the apex of R_1.

The venation is illustrated in fig. 14 following the notation used by Hardy (1981). The costa reaches almost or quite to the apex of the wing and is slightly produced beyond the tip of R_{4+5} in *Bibio*, strongly so in *Dilophus*. The radial sector (R_{4+5}) is simple in British species and is connected to the media by a cross-vein r-m. The media is forked into M_1 and M_2 and connected to CuA_1 by another cross-vein m-cu. The proportions and positions of the cross-veins are of some taxonomic importance.

Abdomen (fig 1). There are eight distinct, fairly equal segments, the ninth forming the genitalia. The abdominal pleura are not longitudinally pleated. In the males the abdominal segments usually carry long hairs and in most species are much more hairy than in the females. In the male the genitalia are not rotated and the ninth segment is usually emarginate apically; there is a pair of gonocoxites fused basally and each carries a fairly simple style; the aedeagus is very largely membranous and is not used for species separation; the tenth segment is below and more or less enclosed in the ninth, and carries a pair of single-segmented cerci. In the female the ninth and tenth segments are small and there is a pair of cerci similar to those of the male; the ninth sternite forms a genital fork or egg-guide. There are three spherical spermathecae. Except for two species of *Dilophus,* in the British species the male genitalia show only small differences between the species which are better separated by other, more obvious characters.

Table 2: Summary of damage caused by bibionid larvae

Species & crop	Locality	Notes	Reference
Dilophus febrilis			
Spring barley	E. Matfen, Northumberland	Hollowed out seed, coleoptile and eaten below ground level, April. Pig manure spread previous July. 2.5ha of 5ha field completely destroyed. Max. numbers 3,500 larvae/sq m.	Port & French, 1984
Spring barley	Heddon, Northumberland	Grain and shoots eaten. Grass previous year. 0.3ha of 2ha field badly affected.	Port & French, 1984
Spring barley	N. Yorkshire Wolds	Several ha affected. Spring.	N. French, *in litt.* 1981
Spring barley	Cassington, Oxon.	1 acre eaten bare. May.	H. Roberts, *in litt.* 1980
'cereals'	Edinburgh	May.	D.A. Cooper, *in litt.* 1983
Pasture	Auchincruive, Ayr	Patchy damage to grass. April.	G. Stewart, *in litt.* 1983
Grass (amenity)	Wales	Up to 37,000 larvae/sq.m	Edwards, 1941
	Winchester, Hants.	Playing fields damaged. April.	C.Beck, *in litt.* 1977
	Croydon, Surrey	Lawn grass. March 1938.	Duffield, 1930; Cameron, 1936
	Manchester	Bowling green. August 1948.	RHS, Wisley records
	?	Turf	RHS, Wesley records
Maize	nr Reading, Berks.	Roots attacked. Farmyard manure used. August.	Lovibond, 1938
Sugar beet	nr Colchester, Essex	Plants in state of collapse, superficial resemblance to wireworm attack. Pig manure applied prior to planting. May.	C. Beck, *in litt.* 1978 G. Winder, *in litt.* 1976
Potatoes	Thornborough, Bucks.	Tubers damaged. Heavy dressing manure applied. August.	C. Beck, *in litt.* 1978
	Bridgewater, Somerset	Damaging tubers. 2 ha damaged. Heavily manured previous winter ploughed late spring, planted April, damage December.	M. Savage, *in litt.* 1983
Lettuce	Windsor, Berks.	Damaging plants in frames.	C. Beck, *in litt.* 1978
	Blackwater, Hants	March, 1927	RHS, Wisley records
	Twickenham, Middx	Larval masses at roots. March 1934.	RHS, Wisley records
Hops	Surrey	Damaging roots, 1921.	Edwards, 1925
	—	Damaging roots and crowns.	Theobald 1908; 1909a
Tomato	Bishops' Stortford, Herts	Destroying seedlings	Edwards, 1925
Chrysanthemum	Bradford, Yorks.	Attacking roots, in greenhouse	Edwards, 1925

Bibio hortulanus			
Hops			Theobald, 1913
Anemone japonica	Wisley, Surrey	Attacking roots, February.	Edwards, 1925
Bibio johannis			
Larch	—	Damaging roots of saplings	Edwards, 1925
Winter wheat	Cambridgeshire	Damage during late February — early March, emerged April.	P. Cranston, pers. comm. 1984
Bibio leucopterus			
Grass	—	Larvae around roots	Bryce, 1953
Bibio marci			
Celery	Wisley, Surrey	Attacking roots	Edwards, 1925
Asparagus	Wisley, Surrey	Root damage	Edwards, 1925
Rose	Capel, Hants	Root damage, November 1933	RHS, Wisley records
Saxifraga	Wisley, Surrey	Damage to roots March 1922, adults emerged May.	RHS, Wisley records
Grass (lawn)	Albury, Surrey	Damaging turf at rate of 75-100 cm in 24 hours.	RHS, Wisley records
Lettuce	Walton on Thames, Surrey	March 1945	RHS, Wisley records
Polyanthus	—	Root damage	Anderson, 1919
Bibio nigriventris			
Larch	Dublin, S. Ireland	Attacking roots, May	Edwards, 1925
Larch	Aberdeen	Attacking roots, May	Edwards, 1925
Bibionidae indet.			
Rhubarb	—	—	Theobald, 1909
Celery	Whittlesford, Cambs.	Making shallow burrows in blanched sections of stems, November	M. Savage, *in litt.* 1977
Sugar beet	Suffolk, several sites	"dozens of larvae in a handful of soil often only where inorganic fertilisers used"	W. Thornhill, *in litt.*

been recorded attacking these plants. Most records of damage to cereal crops occur between March and May and, as implied above, frequently occur after fields have been laid to grass. There has been a strong causative association between fertilising with organic manure, which is believed to introduce the larvae, and subsequent damage to crops. However, while this may be a contributory factor, it may be a spurious correlation because larvae frequently feed on growing plants; some cases of damage have been observed where only inorganic fertilisers have been used; and damage by *D. febrilis* and *B. johannis* occurs to lawns and golf-course greens which have not been top-dressed with organic mulches. It may be that soils high in organic content attract ovipositing females. Some species, e.g. *B. marci,* have been recorded emerging from rotten wood (Allen, 1976) or sawdust (Hanson, *in litt.)* and therefore bibionids may not feed exclusively on living plant tissues, adding some credibility to the 'introduction through organic manure' hypothesis.

The highly gregarious habits of larvae, often misinterpreted as a 'nest', usually results in a patchy attack on crops.

A summary of records of bibionids attacking crops or ornamental plants is given in Table 2.

Collection, preparation and examination

Adult bibionids of most species are reasonably common and widespread, although much more collecting and recording is needed before a proper account can be given of their distribution, especially in the less collected parts away from the south-east corner of England. Little is known of their occurrence in Scotland and Ireland. They are frequently very abundant for short periods especially in spring and early summer, although some species are autumnal and can be found as late as October. The males can be caught in a net whilst flying and the females picked off foliage nearby. Undoubtedly the best way to collect them is to look for mating pairs settled on leaves. This automatically ensures the capture of both sexes and each pair should be retained together. Flies may also be collected by sweeping both high and low vegetation, especially flowering Rosaceae and ivy.

The adult flies may be killed with ethyl acetate and then pinned for storage as dry specimens. The larger species can be pinned directly but the smaller ones should be double mounted using stainless steel micro-pins held on a stage of plastazote or "polyporus" (actually strips of the bracket fungus *Piptoporus betulinus*). It is possible to mount them on card triangles using a water-soluble gum. Pairs should both be mounted on the same stage or on card triangles cut with conjoined base. Suitable locality labels with any collecting data should be placed under the specimen on the same pin at the same time, to avoid later confusion. Details of these methods and other standard ways of keeping Diptera can be found in Oldroyd (1970b).

Nowadays it is becoming frequent for Nematocera to be collected in alcohol and kept as a spirit collection. This should be avoided for Bibionidae as dried specimens stay in better condition, retain their colour to a greater extent and are easier to examine than are spirit specimens. In addition, should slide mounts be needed, then dried specimens macerate more effectively in caustic potash.

On the other hand, larvae and pupae must be kept in alcohol, using a size of glass vial suited to the size and quantity of specimens. They should be placed in 70-80% alcohol and labels written in pencil or waterproof ink inserted inside the vial. The vial is closed by a wad of cotton wool pushed below the surface of the liquid to exclude air and further alcohol-wetted cotton wool used to fill up to the top of the tube. The vials are inverted in a larger jar containing alcohol and with a liquid-proof closure. This method reduces the necessity of topping up to replace loss through evaporation.

Larvae can be found in groups in rich leaf mould, in dung and in woodland and pasture

soil. They are usually found by chance or at the roots of damaged plants, but no doubt could be found regularly in areas where adults were known to be common. Salt & Hollick (1944) suggest that sampling for bibionid larvae on agricultural land requires 40 cores of 10 cm diameter and 15 cm deep to be taken per field, or four cores of the same size per small plot (see Clements, 1982). Quantitative sampling for these larvae is very difficult because of their clumped distribution in a habitat. Patches of larvae vary in size from 10 cm to over 1 m in diameter. Heavy infestations may cover substantial portions of fields. Ploughing may be responsible for breaking up and distributing the clumps of larvae. Morris (1921) describes how females can be induced to lay eggs in jars containing a 3 cm depth of fine soil. The resulting larvae can be reared in leaf mould or compost. If possible, larvae to be preserved should have reached the fourth instar.

Most characters of the adult flies can be seen in dried specimens using the medium or low power of a stereoscopic binocular miscroscope. Only rarely are slide mounts needed and where necessary these can be prepared by soaking the parts to be examined overnight in 10% caustic potash. They are then placed in glacial acetic acid to neutralize the potash, transferred to oil of cloves and mounted in Canada balsam. As an alternative, the parts can be taken from the acetic acid to 80% and then 95% alcohol before mounting in Euparal. In either case it will be necessary to support the cover slip on broken pieces of thick cover slip or tiny pieces of broken slide to prevent the parts from being crushed as the mount dries. With these thicker mounts, it is usually necessary to add further mountant from time to time.

When identifying a larva, the best procedure is to cut out the dorsal part of abdominal segment 4, clean the muscle away and to transfer it for a few minutes from 80% to 95% alcohol. It can then be mounted on a microscope slide in Euparal. These mounts are quick to make and very effective.

The colour of the long hair covering the body is often used to distinguish species, particularly in the genus *Bibio*. Natural or diffused light should be used during examination, as occasionally the shining surface of black hair can falsely appear pale when viewed under an intense beam of light.

Check list

The following check list updates that in Kloet & Hincks (1976). A total of 20 species in two genera are included.

BIBIONOIDEA
BIBIONIDAE
DILOPHUS Meigen, 1803
bispinosus Lundstroem, 1913
febrilis (Linnaeus, 1758)
  vulgaris Meigen, 1818
  brevifemur Lundstroem, 1913
femoratus Meigen, 1804
humeralis Zetterstedt, 1850
BIBIO Geoffroy, 1762
  PULLATA Harris, 1780
anglicus Verrall, 1869
clavipes Meigen, 1818
edwardsi Freeman & Lane, **sp. n.**
  hybridus Edwards, 1925, *nec* Halliday, 1833
ferruginatus (Linnaeus, 1767)
hortulanus (Linnaeus, 1758)
  ? citrius (Harris, 1780)
hybridus Haliday, 1833
johannis (Linnaeus, 1767)
lanigerus Meigen, 1818
lepidus Loew, 1871
leucopterus (Meigen, 1804)
marci (Linnaeus, 1758)
  funerosus (Harris, 1780)
nigriventris Haliday, 1833
  lacteipennis Zetterstedt, 1850
pomonae (Fabricius, 1775)
  funestus (Harris, 1780)
reticulatus Loew, 1846
varipes Meigen, 1830
venosus (Meigen, 1804)

NOMINA DUBIA
parvus Harris, 1780 (*Pullata*)
minima Harris, 1780 (*Pullata*)
minusculus Harris, 1780 (*Pullata*)

Key to genera

Fore tibia with apical circlet of 7-9 stout spines and an additional medial group of 1-4 spines (figs 20-23); front coxa almost as large as femur (fig. 2); pronotum large, with two transverse rows of short backwardly projecting spines (fig. 2); costa extending well beyond tip of R_{4+5} (fig. 15) ..... **Dilophus** Meigen (p.14)

Fore tibia without apical circlet of spines, but ending in large apical spine on outer side and with smaller articulated spur as well (figs 24-26), no medial groups of spines; front coxa much smaller than femur (fig. 1); pronotum smaller, without rows of spines (fig. 1); costa ending at or only slightly beyond tip of R_{4+5} (fig. 14) ..... **Bibio** Geoffroy (p.15)

Genus **Dilophus** Meigen

Dilophus Meigen, 1803: 269 (type species *Tipula febrilis* Linnaeus, 1758); Edwards, 1925: 264; Duda, 1930: 20; Hardy, 1958: 22 (as *Philia q.v.*); 1981: 221.

The definition of this genus is covered in the key to genera. The species are mostly blackish, sometimes with reddish legs, especially in the females, the female of one species is ochreous. The wings of males are clear or milky white, those of females may be clear, pale yellow or smoky in colour.

For a long time, several authors used the name *Philia* Meigen, 1800 for this genus. Now that the controversy over the Meigen names has been resolved by the International Commission on Zoological Nomenclature (Opinion 678), *Philia* Meigen, 1800 may no longer be used for *Dilophus*.

There are four British species.

Key to species

1 Tibia of front leg with medial or sub-medial group of spines arranged in two clear rows (figs 20, 21) so that at least one spine is obviously distal to the main central row, which never has more than three spines; antennal flagellum with eleven segments in at least one species (fig. 2), the last being very small 2

— Tibia of front leg with medial group of spines arranged in a single oblique row, always consisting of four spines (figs 22, 23); antennal flagellum with ten segments only, the apical one sometimes not clearly differentiated 3

2 Front tibia with single spine placed distal to the main group (fig. 20) which normally contains three, but is occasionally reduced to two; body and legs completely black in both sexes, hairs of thorax and abdomen white; dorsum of thorax brightly shining, without conspicuous dull areas; male not unusually hairy; wings of male clear, with distinct stigma, of female smoky with pale tips; flagellum with eleven segments, the apical one small (figs 2, 3). (Some small Scottish specimens lack the single distal spine but are otherwise quite typical.) Wing length 3.5-7.0 mm. ..... **febrilis** (Linnaeus)
Abundant everywhere in spring and again at various times during the year especially late summer and autumn (recorded all warmer months), with a minimum of two broods; male swarms rather low down. Berks, Clwyd, Cornwall, Derbys, Devon, E. Sussex, Essex, Gloucs, Hants, Herts, Kent, London, Lancs, Powys, Oxon, Salop, S. Glam, Somerset, Suffolk, Surrey, Warwicks, W. Glam, W. Sussex, Wilts. Scotland: Strathclyde, W. Isles, Ireland: Wicklow. iv-x.

— Front tibia with two spines placed distal to the medial row of two (fig. 21) which are rather basal to centre; body of male black, shoulders brownish, body of female mainly ochreous; legs of female predominantly yellow, antennae black with scape and pedicel yellow; wings pale yellowish with indistinct stigma; flagellum with ten segments. Wing length 4.25 mm. ..... **bispinosus** Lundstroem
Rare, only females recorded from Britain. Berks (ex swift's crop), Herts, Suffolk. viii-ix.

3 Male genitalia seen from below, more deeply indented between coxites (fig. 6), styles broad and rounded apically; head of female (fig. 4) longer so that distance from ocelli to base of antennae is more than 1.75 times distance between eyes, head less hairy and eyes with short interfacetal hairs; female palpi longer, segment 2 without strongly defined sensory area; body in both sexes almost completely black and shining with white hairs, sides of pronotum of female usually more or less reddish brown but not strongly so; male legs black, of female usually partially reddish, front coxae particularly so; wings of both sexes clear with distinct stigma in female, hardly visible in male. Wing length 3.5-5.0 mm . . . **femoratus** Meigen
Common but not as abundant as febrilis, *said to be single-brooded and most specimens iii-vi, but two in vii and viii suggest it may be partially double-brooded. Cambs, Cornwall, Cheshire, Dorset, E. Sussex, Gloucs, Gwynedd, Hants, Herts, Kent, Lancs, London, Salop, W. Sussex, Worcs. Scotland: Borders, Grampian, Highland, Lothian, W. Isles. Ireland: Clare, Kildare, Kerry, Wexford, Wicklow. iii-viii.*

— Posterior margin of male genitalia less deeply indented (fig. 7), styles pointed at apex; head of female shorter, so that distance from ocelli to base of antennae is less than 1.5 times distance between eyes (fig. 5), head with longer hairs, eyes with longer interfacetal hairs; female palpi shorter, segment 2 broader and with well developed sensory area; body and leg colour as in *femoratus* but sides of pronotum strongly reddish in female; wings of male colourless, of female slightly yellowish and stigma brown, less distinct than in *femoratus*. Wing length 3.5-4.0 mm. . . . . **humeralis** Zetterstedt.
Not as common as femoratus *but widely distributed, possibly double-brooded. Cornwall, E. Sussex, Herts, London, Suffolk. ii-iv and viii.*

Genus **Bibio** Geoffroy

Bibio Geoffroy, 1762: 571 (type species *Tipula hortulana* Linnaeus, 1758); Edwards, 1925: 266; Duda, 1930: 38; Hardy, 1958: 11; 1981: 221.

As with *Dilophus,* the definition of this genus is covered in the key to genera. The males of most species are blackish and hairy, but the females of a number of the species have partially reddish bodies and this sex is much less hairy. We are recognizing 16 species as British, raising *hybridus* to full species rank (see below) and describing a variety of *varipes* as a new species. Most of the species are fairly easy to identify and the key is to a great extent a revision and enlargement of that given by Edwards (1925). The difficult species are those commencing at couplet 11 (the *varipes* species-group) and here there is some divergence from Edwards' key.

Edwards (1925) distinguished a variety of *varipes* Meigen which had pale thoracic hair in the male and a long posterior basitarsus, using the name *hybridus* Haliday for it. Unfortunately, Haliday's *hybridus* is described (1833: 157) as having black thoracic hair. This means that Edwards' variety cannot be the same and needs a new name as it has not been formally described. We propose to call it *Bibio edwardsi* sp. n. (*q.v.*). There are thus four species in the *varipes*-group: *varipes* and *edwardsi* with longer posterior basitarsi in the male, and *lanigerus* and *hybridus* with shorter, more swollen, male posterior basitarsi.

Edwards was the first person to point out that different species had differing numbers of segments in the antennal flagellum, varying from five (*nigriventris*) to eight or nine (*venosus*). However, we have found that this is a character that must be used with caution as the apical segments are occasionally fused, thus reducing the number of segments by one, whilst in *nigriventris* specimens occur with six segments instead of the more usual five.

Most species seem to be reasonably common and widely distributed although, as with so many insects, the records tend to come from areas frequented by entomologists interested in the particular group. For example, most species are recorded from Hertfordshire (F.W. Edwards), East Anglia (Verrall and Collin), New Forest (many collectors) and Aviemore (several collectors). However, by studying the localities

something can be gleaned. For instance, *B. pomonae* is a species found where heather is dominant, particularly in upland situations and it appears to have two broods. *B. nigriventris* has more Scottish records than most species, but this may be because its flight period coincides with the common collecting months, whilst the abundant species *B. marci* has only one Scottish record, perhaps because it flies early in the year.

According to Edwards (1925) *B. lanigerus* is frequent in coastal localities and *varipes* prefers woodland. He states that in *pomonae* and *hortulanus* the males fly singly and do not show the more usual gregariousness. However, the males of *pomonae* have been seen to form loose swarms on two occasions by one of us (R.P.L.)

Key to species

1 Front tibia longer, not swollen in either sex (fig. 24), hind tibia of male likewise not swollen; front tibial outer spine less than one third as long as tibia; posterior legs with femur swollen on apical half, tibial spurs slender and acute, tarsi slender; head, body and legs black, humeri yellowish, legs sometimes slightly brownish; body hair not particularly long and not conspicuous, mainly whitish; thorax wrinkled and dull dorsally along areas of muscle attachment, shining along hair lines; antennal flagellum said to have nine segments, but the last two usually fused making eight clear segments. Wings with faint brownish suffusions, stigma brown and oval, posterior veins darkened, but paler than anterior ones, base of R_{4+5} and r-m subequal. Wing length 8-10 mm ..... **venosus** (Meigen)
Cambs, Devon, Hants, Hereford & Worcs, Herts, London, Somerset, Surrey, W. Glam. iv-v.

— Front tibia shorter, conspicuously swollen in both sexes (figs. 25, 26) hind tibia of males also frequently swollen, outer spine of front tibia over half length of tibia 2

2 Front tibial spur almost equal in length to outer spine (fig. 25); posterior legs with femora evenly swollen, swelling starting before middle, as in fig. 32, tibial spurs slender and acute (fig. 33), tarsi not swollen; body and legs completely black, notal muscle attachment areas wrinkled, shining along hair lines; hairs of male quite long, black and plentiful, of female short and not conspicuous, partially whitish; antennal flagellum with nine segments, the last two sometimes more or less fused. Wings of male milky white, of female with smoky suffusion especially in costal cell, stigma oval and brown, posterior veins very pale in male, darker in female, base of R_{4+5} and r-m subequal. Wing length 5.5-8.0 mm. ..... **leucopterus** (Meigen)
Berks, Cambs, Cheshire, Cornwall, Dorset, E. Sussex, Gwynedd, Hants, Hereford & Worcs, Herts, Kent, Northumb, Oxon, Somerset, Suffolk, Surrey, Warwicks, W. Sussex. Ireland: Killarney.

— Front tibia with outer spine much longer and stronger than inner spur (fig. 26) 3

3 Basal section of R_{4+5} at least twice as long as r-m (figs 16, 17); antennal flagellum with seven clear segments and an eighth sometimes separated from the seventh; large flies with wing length exceeding 7mm. 4

— Basal section of R_{4+5} approximately equal to r-m (figs 18, 19); antennal flagellum various; smaller species with wing length no more than 7 mm. 6

4 Femora red, often strikingly so, remainder of legs black or very dark brown; head, thorax and abdomen black in both sexes, notum dull and slightly wrinkled on areas of muscle attachment, shining between; hairs dense and long in male, blackish in both sexes; posterior femora starting to swell at about the middle, posterior tibia of male evenly swollen, its spurs in both sexes flattened and blunt, male posterior tarsi with basal segment rather swollen (fig. 37); wings clear with indistinct stigma even in female, costal cell brownish, posterior veins pale and indistinct, much paler than anterior ones, base of R_{4+5} about twice as long as the well formed cross vein r-m. Wing length 8-12 mm ..... **pomonae** (Fabricius)
Found particularly in hilly or mountainous districts, apparently double-brooded with spring and late summer peaks. Cambs, Clwyd, Cornwall, Cumbria, Devon, Essex, Gloucs, Gwynedd, Hants, Hereford & Worcester, Herts, Powys, Salop, Surrey, Wilts. Scotland: Borders, Grampian, Highland, Strathclyde (Arran), Tayside. Ireland: Co Kerry, Co Cork. v-x.

— Legs all black, posterior basitarsus of male not, or less swollen (fig. 36), body of female may be red 5

5 Larger species, hair on abdomen and thoracic pleura and notum black or dark in both sexes, exceptionally long in male, interfacetal hairs of male eyes particularly long and dense, about one third as long as widest part of eye; notum entirely shining black, whole body black in both sexes; posterior femora of both sexes and posterior tibia of male more evenly swollen than in *pomonae,* posterior basitarsus of male not swollen (fig. 36), spurs of posterior tibia flattened and blunt (fig. 34), especially in female; wings of male practically clear with darkened costal cell, of female smoky, much darker along costal margin and paler posteriorly, stigma dark brown; posterior veins pale but quite distinct; base of R_{4+5} more than twice as long as the well-formed cross-vein r-m (fig. 16). Wing length 8-12 mm .... **marci** (Linnaeus)
One of the commonest and most conspicuous species of the genus. Berks, Cambs, Cornwall, Devon, Dorset, Essex, Gloucs, Hants, Hereford & Worcs, Herts, Kent, London, Oxon, Somerset, Suffolk, Surrey, W. Sussex, Wilts. Scotland : Highland. iv-vi.

— Smaller species, pleural and abdominal hair white in both sexes, blackish on male notum, not exceptionally long in male, male eyes with shorter hairs, no more than one fifth as long as widest part of eye; whole body of male black with dull muscle insertion areas on notum; female with head, prothorax, scutellum, postnotum and pleura black, notum and abdomen orange red; posterior femora and tibiae as in *marci,* posterior tarsi of male slightly swollen, spurs of posterior tibiae flattened and blunt, those of female strikingly so; wings of male more or less clear, dark along costal margin, stigma distinct, wings of female more smoky, dark costal area broader, tip clearer, stigma distinct; base of R_{4+5} over twice as long as cross-vein r-m, which is often nearly obliterated so that the proportion is even greater (fig. 17). Wing length 5.5-9.9 mm. ..... **hortulanus** (Linnaeus)
Berks, E. Sussex, Essex, Herts, Hereford & Worcs, Kent, London, Norfolk, Oxon, Suffolk, Surrey, W. Sussex. v-vi.

6 Posterior femora of both sexes and posterior tibia of male, slender to about the middle, apical half swollen (fig. 31), first segment of posterior tarsus of male strongly swollen 7

— Posterior femora of both sexes and male posterior tibia commencing to swell well before the middle (fig. 32), male posterior basitarsus various 8

7 Stigma paler, not extending into tip of costal cell (fig. 18); palpi well developed (fig. 29), segment 5 five times as long as wide; male all black, notum shining, hardly wrinkled; hair on abdomen and thoracic pleura white, on notum short and black, and confined to dorso-central rows and supra-alar areas, legs black; body of female mostly reddish and with three blackish stripes on notum on muscle attachment areas, hairs all white, head black, legs reddish; tibial spurs of posterior legs not flattened, posterior tibiae and tarsi not swollen in the female; wing membrane whitish, posterior veins paler than anterior ones, base of R_{4+5} usually shorter than r-m but variable. Wing length 4.5-6.5 mm. ..... **clavipes** Meigen
Bucks, Herts, Hereford & Worcs, Norfolk, Oxon, Powys, Surrey. Scotland: Borders, Highland, Lothian, Strathclyde. Ireland: Killarney, Wicklow. vii-x.

— Stigma darker, well formed and extending into costal cell (fig. 19); palpi shorter (fig. 30), segment 5 less than four times as long as wide; male all black; body of female black, legs reddish; wings more transparent. Very similar to *clavipes,* but stigma and palpal characters give reliable species separation as well as the female body colour. Wing length 4.5-6.5 mm ..... **lepidus** Loew
Bucks, Hants, Herts, Hereford & Worcs, Kent, London, Oxon. ix-x.

8 Antennal flagellum in both sexes with only five segments (fig. 28) or rarely six; body black in both sexes, notum slightly wrinkled; hairs of male black, of female whitish, eye hairs of male long, 0.25 times eye width; legs reddish, in male coxae and femora black, also tibiae sometimes darkened, posterior basitarsus not swollen; spurs of posterior tibia of female somewhat flattened and blunt but not strongly so; wings of male milky, of female slightly brownish, stigma distinct and blackish, posterior veins clearly marked but paler than anterior ones, base of R_{4+5} subequal to cross-vein r-m. Wing length 4.5-6.5 mm. .... **nigriventris** Haliday
Cambs, Cumbria, Devon, E. Sussex, Gloucs, Hants, Hereford & Worcs, Herts, Kent, Lancs, Powys, Suffolk, Surrey, Warwicks, W. Sussex. Scotland: Central, Grampian, Highland, Lothian, Strathclyde (Jura), Tayside. v-vii.

— Flagellum with at least seven clear segments; pubescence various 9

9 Legs of both sexes black or blackish; abdomen, or thorax and abdomen of female reddish; flagellum 8-segmented 10

— Legs bright red or yellow, or in some males, at least with posterior tibiae and tarsi reddish or brown; body all black or dark brown in both sexes; antennal flagellum usually with seven, but occasionally with eight or nine segments 11

10 Hair on abdomen black in both sexes, quite long in male; body of male completely black, all hairs black; eye hairs long, about 0.25 times eye width; notum shining, slightly wrinkled; female body mainly reddish orange with head, prothorax, an upper pleural stripe, postnotum and base of abdomen black; thoracic hairs pale; male posterior basitarsus not swollen, posterior tibial spurs of both sexes pointed and not flattened; wings slightly smoky, costal margin dark brown, stigma distinct, base of R_{4+5} slightly shorter than cross-vein r-m, posterior veins pale. Wing length 4.5-7.0 mm ..... **anglicus** Verrall
Essex, Herts, Kent, London, Norfolk, Suffolk, Surrey. iv-v.

— Hair on thorax and abdomen white in both sexes, quite long in male, eye hairs of male as in *anglicus;* body of male completely black, practically all hairs, including those on legs, whitish, notum not shining, conspicuously wrinkled; female head and thorax blackish with pale hair, abdomen reddish with indistinct, dark, mid-dorsal stripe; posterior basitarsus of male not swollen, posterior tibial spurs blunt and flattened especially in female in which they are quite broad; wings, especially of female, more uniformly smoky, not conspicuously darker along costal margin, stigma fainter than in *anglicus,* but easily distinguishable, particularly in male; base of R_{4+5} and r-m subequal, posterior veins slightly paler than anterior ones, darker than in *anglicus.* Wing length 4.5-6.5 mm. **ferruginatus** (Linnaeus)
Uncommon. Herts, Hereford & Worcs, Leics, Suffolk, Surrey. Scotland: Highland. v-vi.

11 Wings clear with all veins almost equally dark, stigma distinct; thorax and abdomen with pale hair, long and dense in male; female posterior tibial spurs strongly flattened and blunt (fig. 35), outer one broad like a duck's bill, male with outer one blunt and flattened; antennal flagellum with seven segments; eye hairs of male as in *anglicus;* notum not shining, wrinkled; male posterior basitarsus slightly swollen, about four times as long as wide; male front tibiae and all femora darkened, posterior tibiae and tarsi reddish; base of R_{4+5} shorter than cross vein r-m. Wing length 5.5-7.5 mm. ..... **reticulatus** Loew
E. Sussex, Essex, Hants, Hereford & Worcs, Herts, Kent, Suffolk, Surrey. Scotland: Highland, Tayside. iv-v.

— Posterior veins much paler, concolorous with membrane; hair colour various; posterior tibial spurs usually conical and pointed, occasionally slightly flattened in females but not strongly so; notum of male usually wrinkled 12

12 Stigma clear cut, blackish, clearly contrasting with costal cell in both sexes; hair on head, thorax and abdomen of male long and all black, in female short and pale; antennal flagellum 7-segmented; body of both sexes black, legs of female ochreous, of male with femora black and posterior basitarsus slightly swollen, about three times as long as wide (fig. 32); wings fairly clear, posterior veins paler than anterior ones; in female, costal cell not depressed at stigma; halteres dark brown or blackish. Wing length 4.5-6.5 mm . **johannis** (Linnaeus)
Avon, Berks, Cambs, Cornwall, Devon, Dyfed, E. Sussex, Essex, Gloucs, Hants, Hereford & Worcs, Herts, Kent, London, Norfolk, Oxon, Somerset, Suffolk, Surrey, Warwicks, W. Sussex. Scotland: Fife, Grampian, Highland, Lothian, Strathclyde. iii-vi.

— Stigma brownish, often quite pale and not clear cut; male abdomen with long whitish hair; legs of female red-brown, more strongly coloured, body hairs of female pale. 13

13 Male posterior basitarsus swollen and shorter, about three times as long as wide in lateral view (fig. 39); stigma pale in both sexes, hardly darker than membrane which is yellowish or pale brown; costa straight in region of stigma, R_1 straight before its upturned tip; halteres blackish 14

— Male posterior basitarsus not very swollen, about four times as long as wide in lateral view (fig. 38); stigma brown, membrane of wing yellowish; costa depressed at stigma, especially in female; R_1 slightly curved before its upturned tip; halteres brown 15

14 Male with long pale hair dorsally on thorax and abdomen, browner on pleura; posterior tibial spurs of female blunt and rather flattened; male coxae and femora black, remainder of legs reddish or yellowish. Wing length 4.5-5.5 mm. ..... **lanigerus** Meigen
Bucks, Cheshire, Cornwall, Derbys, Devon, Essex, Hants, Herts, Kent, Lincs, London, Norfolk, Northumb, N. Yorks, Notts, Oxon, Powys, Salop, Somerset, Suffolk, Surrey, W. Glam. Scotland: Fife, Grampian, Highland, Strathclyde. iv-v.

— Male with much darker hair, brown interspersed with black on dorsum of thorax, brownish on abdomen interspersed with paler hairs; legs as in *lanigerus,* female indistinguishable from *lanigerus*. (Both species best recognized by the shorter, swollen posterior basitarsus of the male and separated by the male hair colour). Wing length 4.5-5.5 mm. **hybridus** Haliday *Berks, Cornwall, Devon, Dorset, Hants, Herts, Kent, Lancs, Norfolk, Somerset, Suffolk, Surrey, W. Sussex. Scotland: Fife. iv-v.*

15 Hair on dorsum of thorax of male black, brown on pleura. Wing length 4.5-7.5 mm. . . . . **varipes** Meigen *Berks, Dorset, Essex, Hants, Hereford & Worcs, Herts, Kent, London, Northumb, Oxon, Somerset, Surrey. Scotland: Highland. Ireland: Wicklow. iv-v.*

— Hair on dorsum of thorax of male and on pleura white, long and conspicuous; antennal flagellum with 7 segments; long hair on male head and legs pale, eye hair at least 0.25 as long as eye width; male coxae, femora and front tibia dark brown, tarsi and posterior tibia pale brown; posterior basitarsus of male at least four times as long as wide, posterior tibial spurs in both sexes conical and more or less pointed; wings yellowish, stigma pale but distinct, posterior veins paler than anterior ones; base of R_{4+5} slightly shorter than r-m; female indistinguishable from *varipes.* Wing length 4.5-6.5 mm. **edwardsi** Freeman & Lane **sp.n.** *Holotype* ♂, *Chippenham, Cambs, 11.v.1895* (G.H. Verrall). *Paratypes: 2*♂, *Herts, Knebworth, 6.v. 1923* (F. W. Edwards); *1*♂, *1*♀ *(in cop.), Devon, Cornwood, 23.iv.1893* (Yerbury); *1*♂, *1*♀ *(in cop.), Derbys, Shirley, 5.v.1872* (G. H. Verrall); *1*♂, *Hants, New Forest, 3.v.1905* (F.C. Adams); *1*♂, *Somerset, Leigh Woods, 29.iv.1959* (A.C. Pont); *1*♂, *1*♀ *(in cop.), Surrey, Ashtead, 4.v.1946* (L. Parmenter); *1*♂, *Scotland, Inverness, Boat of Garten, v.1934* (F. W. Edwards). *There is also 1*♂ *of unknown locality probably in Herefordshire, 1.v.1911, which has not been made a paratype. All specimens are in BM (NH).*

Family Scatopsidae

by Paul Freeman

Introduction

The Scatopsidae are a small family of rather uniform Nematocerous flies. They are comparatively small in size, ranging from about 1.5 mm to 4.0 mm in length and are mostly black and often shining. In descriptions they are frequently described as bare, but in fact all have a clothing of short setae, the bareness probably being in comparison with the Bibionidae, many of which are conspicuously clothed with long setae. Scatopsidae are of no particular economic significance and this, combined with their small size, has caused them to be somewhat neglected by entomologists, although some species are common around mushroom houses and breweries. Thirty-seven species have been recognized as British.

The first attempt at a synoptic work was by Enderlein (1912), who described seven new genera, some on what appeared to be flimsy characters. As a result, when F.W. Edwards published an account of the British species in 1925, he accepted only two of Enderlein's genera, preferring to place the majority of the species in the all-embracing genus *Scatopse* Geoffroy. In two later papers, Enderlein described more genera, whilst in 1912, Kieffer erected the genus *Psectrosciara* for a species from Seychelles which he placed in the family Sciaridae.

Since the Second World War, the American entomologist E. F. Cook, has published extensively on the family, finding more and better characters which have proved the reality of most of Enderlein's generic concepts. Cook's papers have provided a framework of genera, tribes and subfamilies, facilitating a much better understanding of the species and their classification.

Nine species have been added to the British list since Edwards' (1925) keys (see Kloet & Hincks, 1976) and, with Cook's classification, this seems a suitable time to offer a new series of keys. Most of my keys draw heavily on Cook's work, especially his accounts of the Palaearctic fauna. I am describing another new species and a new genus in this Handbook.

Edwards' keys were based to a great extent on easily observed external features — antennal segmentation, wing venation and trichiation, body and leg colour etc., and only to a minor extent on genitalic features. Even so they worked quite well. Later work has shown the great importance of genital structure in both sexes, and several of the species sinced added to the British list can only be separated on these characters. Unlike most other Nematocerous flies, the majority of the species can be identified in both sexes on characters of the genitalia, but for this it is generally necessary to prepare microscope slides, though this is not a particularly difficult task. Wherever possible features other than genital ones have been indicated to reduce the necessity of slide making. A number of species are quite rare or have only been found on one or two occasions, so it is likely that a few more uncommon ones will be added from time to time.

As mentioned on p.4, until 1912 the Scatopsidae were treated as a subfamily of the Bibionidae, and in general appearance, short antennae and wing venation, that family does appear similar, although there are probably more differences than similarities. On the other hand, they clearly belong to the Bibiomorpha, which includes the Bibionidae, Mycetophilidae, Sciaridae and Cecidomyiidae, as indicated by Edwards (1925) and Hennig (1948), though which family is the mostly closely related remains in some doubt, despite the strange resemblance of the front legs of *Aspistes* to those of *Bibio*.

Although showing a number of features that resemble other families, such as the short

thick antennae, not unlike those of Bibionidae and bridged eyes as in the Sciaridae, they are in fact quite distinct from all the above families. The special features that distinguish them are the large single-segmented palpi, absence of true tibial spurs, the distinctive ribbed or pleated abdominal pleural membranes and the complex male genitalia. The larvae and pupae are also quite different from those of other families, at least in those genera for which they have been described.

Structure

In the following short account, emphasis has been placed on features of taxonomic significance. I have followed Cook's (1981) interpretation of the venation.

Head (figs 42-45). In both sexes, seen from the front the head is rounded in *Aspistes* (fig. 42), but in all other genera it shows varying degrees of lateral compression (figs 43-45). It is rounded behind the large compound eyes which occupy the anterior half in all but a very few species, so that they are holoptic; the eyes are setose and three ocelli are present. Antennae are short and stout with 8-12 segments in British species, set well above the oral margin with the eyes curving round them. The antennal segments are generally wider than long, pedicillate and bearing setae. The mouthparts are short but with well-formed and often large labella, the maxillary palpi are single segmented, oval or pointed, rather large and applied to the lower surface of the head, each with one or two or more sensory pits near the apex. There are no sexual differences discernible in the head, except in *Colobostema* in which the females are dichoptic.

Thorax (fig. 46). In most genera the whole thorax is laterally compressed, the scutum being about 1.5 times as long as wide and carrying short hairs. In *Aspistes, Holoplagia* and *Colobostema* the scutum is more or less quadrate. The amount of shininess depends on the density of the microtrichia between the larger bristles. Laterally there is usually a row of supra-alar bristles. The anterior spiracle is either on the anepisternum or, in the Scatopsinae, on a separate sclerite. The postnotal phragma is strongly developed and extends well into the abdomen, usually to the second segment. The thoracic bristle groups mentioned by Cook have not been found to be particularly useful for the British species, though they are sometimes useful in generic diagnosis, but there are other more easily seen features in most cases. Fig. 46 shows the named setal groups used by Cook.

Wings (fig. 41). All British species are fully winged in both sexes. In general appearance the wings are fairly uniform throughout the family, the anterior veins (costa and radius) dark and thickened together with the base of the media and bearing macrotrichia; the posterior veins (medial fork and cubitus) are thinner and pale, often difficult to see in slide mounted or fluid preserved specimens. The latter veins usually do not carry macrotrichia, but their occasional presence is a useful taxonomic character. The membrane is covered with microtrichia, often densely so and with macrotrichia in addition in a few genera. The costa reaches just beyond the apex of R_{4+5} and terminates before the apex of the wing, frequently near the middle or basal to it; R_{4+5} (radial sector) is unbranched in all species; the front margin of the wing is divided for convenience into three sections as indicated. The medial vein is forked into M_1 and M_2 and generally connected to R_{4+5} by a short cross-vein r-m. In Aspistinae and Ectaetiinae, this cross-vein is absent and M is fused to R_{4+5} as shown in figs 59, 62. The base of M_1 is sometimes missing or there may be a short spur near its base whilst in *Holoplagia* and *Cookella* there is a complete supernumerary cross-vein joining M_1 to R_{4+5} (figs 132, 135). Cu has two branches, CuA_1 and CuA_2, connected only at the extreme base of the wing; CuA_1 is usually fairly straight, CuA_2 often doubly bent. A concave false vein or fold lies between M_2 and CuA_1 in Aspistinae and Scatopsinae and has been variously interpreted, but is now considered to be simply a fold; this has considerable taxonomic importance. An anal vein is present or absent, usually rather indistinct and short. Halteres

normally have a few setae on the pedicel but their absence can be a useful generic character.

Legs (figs 40, 58). The coxae are well developed, especially on the front legs where they can be as long as the femora. The femora do not have any special features. The tibiae lack apical spurs but in Aspistinae they have a variety of spines and in this subfamily the front tibia has a long spur-like prolongation (fig. 58). In *Ectaetia* the posterior tibia is expanded apically with a dense comb-like row of setae (fig. 63); other genera often have somewhat similar combs or rows of spines but the tibiae are not expanded. In *Aspistes* (fig. 60) the posterior tibial spines are stronger than usual. The tarsi in general are simple, but the basal segments are sometimes armed below with short, stout, spine-like setae; pulvilli are either very small or absent, but the empodium is well developed, pad-like and hairy.

Abdomen. There are seven clear pregenital segments (only six visible externally in males of *Swammerdamella*), segments 8 and 9 forming part of the genital complex in both sexes. Tergites 1 and 2 are often divided transversely, whilst their sternites may be absent; sternite 7, and even 6, are sometimes modified as part of the genitalia. The abdominal pleura are quite characteristic for the family, being longitudinally pleated or ribbed (fig. 47) and set with setae in a somewhat regular pattern. The tergites and sternites carry setae with microtrichia in between; the more shiny sclerites have few or no microtrichia, on dull sclerites they are present in varying degrees of density. Sternites 6 and 7 may carry thick, short, spiniform setae in some genera (e.g. figs 83-87).

The male genitalia offer some of the best characters for species separation and are also useful for subfamily and generic definition. They are invariably complex and often rotated through 180°. In most species the genitalia are capsule-like and carry one or two pairs of appendages, one pair being regarded as gonocoxites; the other, closer to the penis, as parameres or penis valves, which with the penis can be referred to as the aedeagus. The penis is usually conspicuous and may be elongate, twisted or even bifurcate in a few species. There is a well-developed sperm pump or vesica with a sac-like reservoir and three apodemes for muscle attachment, the single one directed posteriorly. In the Scatopsinae the sperm pump lies apparently freely in the abdominal cavity (in cleared specimens) and is only connected to the penis by the sperm duct (fig 48), which is quite a fine tube. In the other three subfamilies the pump is closely fused to the external genitalic complex and forms part of it (e.g. fig. 78). In the keys, the genital descriptions are usually from the true ventral aspect, though owing to the rotation this may appear to be dorsal.

Female genitalia are more difficult to discern. A pair of conspicuous cerci are generally visible and ventrally one or two pairs of valvifers or hypogynal valves can be seen attached to the reduced 8th and 9th sternites. The genitalia are best examined from below. The single spermatheca is normally easily seen in cleared specimens as a dark, oval, spherical or kidney-shaped organ; in *Ectaetia* the base of the duct appears to be highly modified (fig. 64).

Biology and early stages

Not a great deal is known of the biology and early stages of Scatopsidae. The rather active adults often appear in large numbers or small swarms on leaves, occasionally on fences and similar places or crowded together in confined spaces; they have been recorded inside a tent and once in a chimney (specimens in BM(N)). They can be common in flowers, especially umbels and ivy. Hutson (1973) records four species on a broom bush heavily infested by aphids and two others associated with aphids on a conifer: these may all have been seeking honeydew. Both sexes occur together and there is no evidence of male mating swarms.

Adults are known to take food in the form of nectar or sugar-water and mating takes place soon after emergence. I have been able to observe pairing in *Swammerdamella brevicornis, Scatopse notata* and *Apiloscatopse picea,* in all of which mating takes place tail to tail. The male approaches the female from behind, bends the abdomen sideways and under to achieve coupling and then twists to point backwards the right way up. The pair can run on a flat surface, the female leading and the male running backwards. Females are now ready for egg-laying after which they die. Both sexes appear to live for a few days at the most, in those few species that have been studied. It seems that in the common species *Scatopse notata* and *Coboldia fuscipes,* the cycle from egg to adult in summer temperatures takes 3-4 weeks and that generations follow each other in succession. There is a slowing down in colder weather and the winter is passed either in the larval or in the pupal stages. The majority of the species can be found over several months and quite a number appear in most of the warmer months of the year from April to September. This suggests that it is common for there to be more than one generation each year. However, this cannot apply to *Apiloscatopse,* the species of which appear in the autumn and may well have an annual life-cycle. Further collecting and rearing is needed before any definite general statement can be made on the number of generations throughout the family.

Eggs. Where the life history is known, eggs are laid in damp decaying material usually of vegetable origin, such as rotting bulbs or fruit, but also in manure, rotten wood or under dead bark. In *Scatopse* and *Coboldia* the eggs are whitish and oval and are laid in rows in an egg-mass containing on average about 200 eggs. The dead females are often found close to their egg-masses. Nothing is known of other species but it can be presumed that they are similar.

Larvae. The best-known larvae are those of *Scatopse notata* and *Coboldia fuscipes,* both cosmopolitan species that have been reared from all kinds of rotting material. The larvae of the North American species *Rhexosa similis* (Beekey) and *incisa* Cook have been found under decaying bark of deciduous trees (Cook, 1981) and the Palaearctic species *R. subnitens* has been found in Belgium also under decaying bark (Tonnoir, 1926). Larvae of *Parascatopse litorea* have been found in soil of saltings in Poland (Szadziewski, 1979). The supposed larvae of *Ectaetia platyscelis* have been reared from a wet tree hole (Laurence, 1953), other species of the genus have also emerged from rotten wood. In *Scatopse* and *Coboldia* there are four larval instars. Nothing is known of the details of the early stages of Aspistinae and Psectrosciarinae, although *Aspistes berolinensis* has been reared from sifted litter found in sandy places in Czechoslovakia (Vimmer, 1935).

The larva of *Scatopse notata* (fig. 49) is fairly tough and rather dorso-ventrally flattened. It is usually covered with detritus and needs cleaning with fine needles before examination. The head is oval and non-retractile with conspicuous antennae (fig. 51), which are three-segmented and with a small blade-like process on segment 2 (varying in length in different genera). The mouthparts (fig. 50) have a setose labrum, the ventral surface of which carries complex comb-like setae; premandibles are present. The mandibles are conspicuous and have apical teeth and a basal, upwardly projecting tooth as well as groups of hairs and a curious thick seta (fig. 52). The maxillae are transverse and have a single-segmented palp with sensory pits; there are teeth near the inner margin overlain by a group of hairs. The labium is simple, with numerous setae.

The body consists of three thoracic and nine abdominal segments, each carrying thick setae arranged in a definite pattern as in the figure. The posterior row of thick setae on the first two thoracic segments are reduced to small nodules. Between head and prothorax and between the thoracic segments are numerous very small setae arranged in short comb-like rows (fig. 49a). The ventral surface has a more uniform arrangement of setae.

The larva is peripneustic with one pair of prothoracic and eight pairs of abdominal spiracles, the last pair on abdominal segment 9 being by far the largest. The spiracles are all placed on very characteristic, short sclerotized processes, except for the last pair which

are on much longer cylindrical processes. Posteriorly, the end of the abdomen carries a pair of large, slightly curved reddish brown sclerotized processes which bear long setae spread out like a fan. Ventrally, the anal opening is somewhat triangular and is surrounded by unusually stout setae as well as a row of shorter setae on the outer side (fig. 53).

The larva of *Coboldia fuscipes* is similar in general structure but does not have the regular pattern of dorsal setae, whilst the spiracular peduncles are said to be setose and not bare, and the antennal blade is longer. There is only one row of stout setae, around the anus, and the spiracular cylinders at the end of the abdomen are longer than the sclerotized processes. In the American *Rhexosa similis* there are seven longitudinal rows of abdominal setae instead of the five seen in *Scatopse* and the antennal blade is intermediate in length. Neither species has the nodule-like thick setae on the first two thoracic segments seen in *Scatopse.*

From the published figures and description, the larva of *Parascatopse litorea* (Szadziewski, 1979) has similar mouthparts and spiracles, but lacks the curved brown, sclerotized processes at the end of the abdomen. It has fewer setae which are arranged in transverse or oval bands on the segments, not in longitudinal rows.

The supposed larva of *Ectaetia* (Laurence, 1953) has a more generalized arrangement of setae, although the mouthparts and head resemble those of *Scatopse.* However, instead of two curved processes posteriorly, there is a suboval dark plate and the posterior spiracles are on quite short processes (fig. 54). Laurence states that the lateral spiracles are sessile, but I have examined his slides, and in my opinion they are really on short processes, about half the length of those of *Scatopse.* The prothoracic spiracles are larger than the serial abdominal ones. The posterior dark plate prevents examination of the anus, but as far as can be seen, there is no indication of strong hairs around the opening.

Bovien (1935) states that in the larva of *Scatopse* (= *Coboldia*) *fuscipes* the length of the caudal spiracular processes varies according to the dampness of the breeding medium. In dry medium they are short, whilst in wet surroundings they are long, and such larvae are capable of existing in water, hanging from the water film like some other aquatic Nematocerous larvae, using only their posterior spiracles for respiration.

It is clear that much more rearing is needed for a fuller understanding and description of larvae of all genera. However, it can be said that some head structures, especially the conspicuous antennae and the mouthparts are characteristic, the latter showing more resemblance to Anisopodidae and Trichoceridae than to Bibionidae (Keilin & Tate, 1940; Morris, 1917, 1921, 1922). They differ from all other Nematocerous families by being peripneustic with the spiracles on processes, though whether this is universally true throughout the family remains to be seen. Another characteristic of some of the known species is the presence of paired sclerotized processes or a single plate at the end of the abdomen, a feature of possible generic significance, absent in *Parascatopse.*

Pupa. Pupae are known for *Scatopse notata, Coboldia fuscipes, Rhexosa subnitens* and the American *Rhexosa similis.* In all these the pupa is formed within the last larval skin, which is split along the dorsum of the thorax. This is unusual for Nematocera. The prothoracic spiracles are branched and quite short in *Scatopse* (fig. 55), but forked and with long branches in *Rhexosa* (fig. 56) and also in *Coboldia.* There are six pairs of abdominal spiracles on processes longer than those of the larva and these project through the larval skin.

Collection and preservation

Adult scatopsids are often found in numbers together, sometimes in flowers (with autumn species especially at ivy blossom) or on leaves in woods. Occasionally they are found crowded together in confined spaces: once in a chimney, another time in poppy

seed heads (specimens in BM(NH)). They can be found on fences, on windows or near their larval habitats and can be swept from vegetation or flowers. They are not a particularly conspicuous part of the insect fauna: several species are extremely rare and have only been found once or twice. Virtually nothing more is known of the habits of the adults.

The following twelve species are fairly common and should be found without much difficulty:

Anapausis soluta
Ectaetia clavipes
Rhegmoclema collini
R. coxendix
Swammerdamella brevicornis
Coboldia fuscipes
Cookella albitarsis
Scatopse notata
Reichertella geniculata
Apiloscatopse flavicollis
A. picea
A. scutellata

The adults are best kept dry, either double mounted on fine steel micro-pins or else attached with a water-soluble glue to a card triangle. Both these methods are standard for small Diptera. Surplus specimens are preferably kept dry in small boxes between layers of cellulose wadding (not cotton-wool, which tangles with their appendages), but if preferred they can be placed in small glass vials in 70-80% alcohol.

Specimens preserved in alcohol should be placed in vials 40-50 mm long, 10 mm in diameter and a small plug of cotton-wool (not cellulose in this case) pushed down below the level of the fluid. Labels should be written in pencil or waterproof ink. The vial is then filled to the top and another plug of wadding inserted firmly; it is then inverted into a wide-mouthed, screw-topped jar containing more alcohol with blotting paper at the bottom to prevent damage to the vials. The first plug is essential to prevent the specimens being damaged by movement and air bubbles; inversion into a larger jar simplifies topping up and the small vials are less likely to dry up. Small bottle-shaped vials with a narrower neck should not be used as it is virtually impossible to fill this kind completely with alcohol and to insert the plugs. Specimens in these vials are invariably damaged and lose appendages.

Preservation in alcohol is a simple and popular way of keeping many small insects and has the advantage that they can be easily examined in a watchglass without much danger of breakage, also the genitalia can be examined more easily than in a dried specimen with a stereoscopic microscope without the necessity of making microscope slides. However, after one or two years in alcohol, the flies cease to be readily cleared in potash, and if slides are needed for examination with a higher power, the antennae and other appendages tend to collapse, whilst the wings are difficult to remove and examine. In addition, colour and shininess become obscured. Far better slides are made from dry specimens. If sufficient specimens are collected and are confidently considered to be of the same species, then some can be kept dry and a proportion placed in alcohol.

More details for collecting and preserving small flies can be found in Oldroyd (1970b).

Preparation and examination

Although many of the commoner scatopsids can be identified from external characters of head, wing and leg, it is preferable to mount at least one of each sex on microscope slides. This is essential for closely allied species where critical examinations of male and female genitalia are necessary. All the British species can be separated by the structure of the male genitalia and most species show good characters in the female genitalia as well. Fortunately, when a number of a given species is collected, both sexes are usually found to be present and mating pairs are frequently seen — these should be segregated.

Specimens to be mounted on slides should first have their wings carefully removed with needles and placed in 95% alcohol. The wings are then mounted in Euparal under two 6mm coverslips towards one end of a slide, both pointing the same way, so that one is the right way up and the other upside down, in order to be able to examine both sides for macrotrichia. Do not place the specimen in potash before removing the wings as the latter will become softened and difficult to remove and manoeuvre.

The body is now placed in 10% caustic potash, either overnight in a covered "solid watchglass" or else in a small tube stood in boiling water for 5-10 minutes. After treatment in potash, the body is transferred to glacial acetic acid for 5-10 minutes and then to a cavity slide with a drop of Berlese preservative (see below). Here the abdomen is either separated from the thorax (needs care and practice) or else the abdomen is divided at the middle, using mounted needles and a fine scalpel.

The head and thorax portion is now transferred to a drop of Swan's Berlese mountant (formula below) on the slide carrying the wings. The legs are arranged carefully and three tiny pieces of broken, thick coverslip (no. 2 or 3) placed so that a 6 mm coverslip is supported, and crushing of the body prevented. The genitalia should be displayed suitably, attached to the posterior half of the abdomen, using fine needles, and this part is transferred to another drop of mountant so that the ventral surface is uppermost for most species, though experience will indicate the correct attitude. Again, great care must be taken to put three pieces of broken coverslip to prevent crushing as the mountant dries. To ensure that the genitalia are correctly displayed and do not move, it is sometimes necessary to wait 24 hours and then to add more mountant before applying the coverslip. It is not essential to wait with the head and thorax portion.

It is usually necessary to examine the slides from time to time, topping up with mountant to compensate for evaporation. After the slides have dried for a few months, they should be ringed with Euparal to prevent further evaporation. If preferred, slides can be made either with Euparal for all the parts, mounting direct from 95% alcohol, or with Canada Balsam. The techniques for Canada Balsam are more complex, although it is possible with better sclerotized parts to transfer direct from glacial acetic acid to clove oil and thence to Balsam. However, its refractive index is such that finer structures may be difficult to see.

Slides need to be examined with a high-powered microscope as well as with the low-powered stereoscopic instrument necessary for making the mounts. Oil immersion lenses are not needed, features such as microtrichia being visible with normal lenses.

Formulae (after Dr K.M. Harris)

Swan's Berlese Mountant

Gum arabic	12g
Chloral hydrate	20g
Glacial acetic acid	5ml
50% w/w glucose syrup	5ml
Distilled water	30-40ml

Measure ingredients into a beaker or wide-mouthed bottle (the glucose syrup is made by dissolving a given weight of glucose in an equal weight of distilled water). Place in gentle heat (slide-oven at 35°C) for 24 hours or more, stirring occasionally until ingredients dissolve. Leave for a few days until debris from the gum arabic settles and then decant clear fluid into a clean screw-top bottle. If necessary, evaporate water by leaving open container in slide-oven for a few days, until drops of mountant retain their shape on a slide rather than running freely over the surface.

Berlese Preservative

This is prepared in the same way as the Berlese mountant but gum arabic is omitted from the above formula. This produces a clear fluid that does not set and in which

specimens may be kept more or less indefinitely and mounted as required. It may thicken as a result of evaporation but can easily be thinned by the addition of small amounts of distilled water.

Check list

The following check list updates that in Kloet & Hincks (1976). A total of 36 species in 14 genera are included.

SCATOPSIDAE
ASPISTINAE
ASPISTES Meigen, 1818
berolinensis Meigen, 1818
ECTAETIINAE
ECTAETIA Enderlein, 1912
clavipes (Loew, H., 1846)
lignicola Edwards, 1925
platyscelis (Loew,H., 1846)
PSECTROSCIARINAE
ANAPAUSIS Enderlein, 1912
palustris (Edwards, 1925)
soluta: Duda, 1928, nec (Loew, H., 1846)
soluta (Loew, H., 1846)
tenuicauda Duda, 1928
inermis: Brit. auctt., nec (Ruthé, 1831)
talpae (Verrall, 1912)
SCATOPSINAE
RHEGMOCLEMATINI
RHEGMOCLEMA Enderlein, 1912
ALDROVANDIELLA Enderlein, 1912
PSECTROSCIARA: Edwards, 1925 in part, nec Kieffer, 1911; Collin, 1954
collini Cook, 1969
halterata: (Duda, 1928), nec (Meigen, 1838)
cooki Hutson, 1970
coxendix (Verrall, 1912)
edwardsi (Collin, 1954)
halteratum (Meigen, 1838)
winthemi (Duda, 1928) in part
verralli (Edwards, 1934)
PARASCATOPSE Cook, 1955
litorea (Edwards, 1925)
minutissima (Verrall, 1886)
SWAMMERDAMELLINI
SWAMMERDAMELLA Enderlein, 1912
acuta Cook, 1956
brevicornis (Meigen, 1830)
COBOLDIA Melander, 1916
RHAEBOZA Enderlein, 1936
fuscipes (Meigen, 1830)
simplex (Walker, 1856)
minuta: (Walker, 1856), nec (Meigen, 1818)
RHEXOSA Enderlein, 1936
richardsi Freeman, **sp.n.**
subnitens (Verrall, 1886)
nigra (Edwards, 1925), nec (Meigen, 1804)
SCATOPSINI
COLOBOSTEMA Enderlein, 1926
nigripenne Meigen, 1830)
infumata (Halliday, 1833)
triste (Zetterstedt, 1850)
oldenbergi Enderlein, 1926
HOLOPLAGIA Enderlein, 1912
bullata (Edwards, 1925)
richardsi (Edwards, 1934)
transversalis (Loew, H., 1846) nec Enderlein, 1912
COOKELLA Freeman, **gen. n.**
albitarsis (Zetterstedt, 1850)
SCATOPSE Geoffroy, 1762
lapponica Duda, 1928
notata (Linnaeus, 1758)
REICHERTELLA Enderlein, 1912
S. REICHERTELLA s.s.
geniculata (Zetterstedt, 1850)
consimilis (Walker, 1856)
pulicaria (Loew, H., 1846)
integrata (Walker, 1856)
FERNEIELLA Cook, **gen. n.**
brevifurca (Enderlein, 1912)
incompleta (Verrall, 1886)
APILOSCATOPSE Cooke, 1974
bifilata (Walker, 1856)
bifiliata Cook, 1974 (laps. cal.)
flavicollis (Meigen, 1818)
flavocincta (Duda, 1928)
picea (Meigen, 1818)
scutellata (Loew, H., 1846)
cochleata (Duda, 1928)

Key to subfamilies

1 Thoracic scutum with elevated U-shaped ridge (fig. 57); eyes dichoptic in both sexes (fig. 42); head and thorax not laterally compressed; front tibia in both sexes produced into strong spine (fig. 58); costa swollen at junction with R_{4+5} (fig. 59) ..... **Aspistinae** (p.28)

— Thorax normal, frequently laterally compressed; eyes holoptic in both sexes except in female *Colobostema;* front tibia not produced; costa not swollen at apex 2

2 Wing with false vein present as concave fold between M_2 and CuA_1 (fig. 41); male sperm pump free in abdomen in cleared specimens, only attached to genital capsule by fine, transparent sperm duct (fig. 48) ..... **Scatopsinae** (p.32)

— Wing without false vein (figs 62, 73); male sperm pump attached to genital capsule and not free in abdomen (figs 65, 77) 3

3 Wing membrane without macrotrichia, macrotrichia present on veins CuA_2 and A, absent from branches of M and CuA_1; stem of M_{1+2} arising distal to base of R_{4+5} (fig. 62); posterior tibia enlarged and flattened at apex, with close comb of short, fine, bristles on inner side (fig. 63) ..... **Ectaetiinae** (p.29)

— Wing membrane with distinct, fine macrotrichia scattered over posterior cells and present on branches of M and CuA (figs 73, 74); stem of M_{1+2} arising near base of R_{4+5}; posterior tibia not enlarged and flattened at apex ..... **Psectrosciarinae** (p.30)

Subfamily Aspistinae

The subfamily contains two rather similar genera, *Aspistes* Meigen and *Arthria* Kirby, separated mainly by the antennal segmentation and trichiation of the wing veins. Only *Aspistes* has so far been recorded from Britain. *Arthria,* with 7-segmented antennae in both sexes and more macrotrichia on the base of M, occurs in northern Europe and Siberia, so it is possible that it might be found in Scotland.

Species of both genera are quite unmistakable because of the peculiar mesoscutum and the characteristic tibiae of all legs. Although the single British species is rare, as it is associated with sandy habitats, further collecting in coastal sand-dunes and other sandy places may show it to be more widely distributed.

The subfamily is interesting because the leg structure with its spines is very suggestive of the family Bibionidae, and because of the separated (dichoptic) eyes which, with the broad thorax, suggest a primitive condition. However, the sperm pump is well developed and joined to the genital capsule; the wing venation, though distinctive, is of a scatopsid type and the abdominal pleura are pleated.

Genus **Aspistes** Meigen

Aspistes Meigen, 1818: 319 (type species *Aspistes berolinensis* Meigen, 1818); Edwards, 1925: 268; Duda, 1928: 54; Cook, 1963: 20; 1981: 317.

Fairly large, stout species, head and body not compressed, eyes dichoptic in both sexes, separated by distance between antennae (fig. 42), nearly bare; antennae of male with 10-12 segments, of female 8-segmented; maxillary palpi unusually small, about half length of labella which are large and without pseudotracheae. Thorax short, stout and not laterally compressed, metanotum with only a small projection into the abdomen, barely half as long as in other genera (compare fig. 46). Scutum quite characteristic and highly unusual, with a U-shaped hairy, slightly rugose plate anteriorly, outlined by a raised ridge and rising to a central crest (fig. 57), giving a humped appearance; anterior spiracle set in the anterior anepisternum. Legs stout, front coxae large, nearly as large as the femora which bear spines, front tibiae produced into a long spur and also with spines, giving a prehensile appearance (fig. 58); apices of tibiae of mid and hind legs with rows of stout spines (fig. 60). Wing venation (fig. 59) with broad radial cell, but section 2 of costa much shorter than both 1 and 3, costa swollen at

junction with R_{4+5}, base of M_1 incomplete, false vein present between M and CuA, anal vein reaching margin, macrotrichia absent from veins M, CuA and An and from membrane. Pedicel of halteres bare. Sperm pump of male fused to genital capsule, segment 8 of both sexes well developed, triangular, rugose and spiny (fig. 61).

There is one British species:

— Stout and blackish, male antennae with 12 segments, female with 8 segments; easily recognized by generic characters, especially thorax, legs, wings and apex of abdomen (figs 57-61). Wing length 2.25-2.50mm ..... **berolinensis** Meigen
Rare, associated with sandy places, in Britain apparently with coastal sand-dunes but Continental records are from far inland. Adults have been reared in Czechoslovakia from sifted litter, where it is thought there are at least two generations a year (Vimmer, 1935). Cornwall (on rowan), Devon, Mid-Glam. v-viii.

Subfamily Ectaetiinae

A small subfamily of only one genus, three species of which are British. They are not very common but have a wide distribution and the genus is readily recognized by the wing venation and posterior tibial structure. In the length of the front coxa and the position of the anterior thoracic spiracle, a resemblance is seen with the Psectrosciarinae but the wing venation is perhaps more like that of the Aspistinae. All three subfamilies are united by the fusion of sperm pump to the genital capsule.

Genus **Ectaetia** Enderlein

Ectaetia Enderlein, 1912: 279 (type species *Scatopse clavipes* Loew, 1846); Edwards, 1925: 269; Duda, 1928: 52; Cook, 1963: 19; 1981: 318.

Body laterally compressed, head oval seen from the front; eyes strongly holoptic, meeting above the antennae by at least 6 facets and sometimes more; palpi and labella rather small, the latter with a single simple pseudotrachea on each, readily seen when observed carefully under high power; antennae 12-segmented. Anterior spiracle of thorax on a partially separated and rather long sclerite of anterior anepisternite; front coxae long, 0.8 length of femora, hind tibia dilated at apex (fig. 63), bearing a close comb-like row of setae at inner apex and a patch of curved setae as well; halteres with at least four setae on pedicel. Wing venation (fig. 62) with R_{4+5} ending near middle of costal margin, section 2 less than half length of section 3; radial cell quite broad, M joining R_{4+5} well distal to its basal bend so that cross-vein r-m is absent and M and Rs are fused; false vein absent; wing membrane without macrotrichia but these are present on CuA_2 and A. Male with sperm pump closely joined to external genitalia (figs 65-67) which have one pair of movable appendages (stippled in figs); penis distinct and either forked or apically dilated. Females with a single, quite large, kidney-shaped spermatheca, with the duct joining it towards one end of the concave surface; base of spermathecal duct highly modified at its junction with the female genital capsule (fig. 64): see note below.

Ectaetia is a distinctive genus of shining blackish species, easily recognized by wing and leg characters. Adults have been reared from rotten wood and the presumed larvae of one species described from specimens found in a rot-hole in a lime tree.

Cook (1963) states that the spermatheca is highly modified and gives a figure of the structure I have illustrated in fig. 64. I have examined several females of all three British species and find that all have a well-developed, fairly normal spermatheca, usually dark but paler in *lignicola*. The spermatheca differs from that seen in other genera by its kidney-shaped rather than oval or circular outline. The peculiar structure figured seems

to be the modified basal section of the spermathecal duct and not the spermatheca itself: in carefully prepared slides, the duct can be seen emerging from the apex and joining the spermatheca. This structure is well developed in *clavipes* and *lignicola* but less developed, paler and more difficult to make out in *platyscelis*. In order to demonstrate it, it is best to dissect the genital capsule from the rest of the abdomen on a slide in the mounting medium, and the structure can then be seen at the point where the spermathecal duct leaves the genital capsule. It might, of course, be part of the vagina or a bursa copulatrix.

The genus is unusual in the presence of a single, rather simple, pseudotrachea to each labellum. When first examined these are difficult to make out, but when recognized, they can readily be observed in well-prepared slides by the row of short spines along their length. As far as is known, no other genus in the family possesses these structures.

Key to species

1 Tergites 2-5 of abdomen densely clothed with microtrichia between the macrotrichia, so that they appear dull and not shining, microtrichia absent from tergites 1 and 6-7 which, as a result are shining; in most specimens at least 8 macrotrichia on CuA_2 — but this is not a very reliable character. Appendages of male genitalia (stippled in fig. 65) bulky and with hairy process basally, outline of capsule complex, penis ribbon-like and forked (fig. 68). 7th sternite of female (fig. 71) with deep rounded emargination, thickened centrally, 7th tergite also strongly emarginate (fig. 70). Wing length 2.9-3.75 mm . **platyscelis** (Loew)
Reared from rotting beech, elm and lime, not uncommon. Berks, Bucks, Hants, Herts, Norfolk, Somerset, Surrey. iv-vii.

— Microtrichia absent from all abdominal segments so that all are shining; usually less than 8 macrotrichia on CuA_2; 7th tergite and sternite of female not like this 2

2 Appendages of male genitalia spoon-shaped (stippled in fig. 66), outline of genital capsule simpler; penis expanded apically (fig. 69) and not forked; halteres pale. Eyes not unduly large in either sex, not reaching ocelli and meeting by about six facets. 7th sternite of female with V-shaped emargination without central thickening (fig. 72), 7th tergite with apical margin with slight curved emargination. Wing length 2.0-2.5 mm. ....**clavipes** (Loew)
The commonest species, reared from rotten wood. Cambs, East Sussex, Herts, Kent, Oxon. v-ix.

— Appendages of male genitalia shorter, thicker and with two branches (fig. 67), outline of genital capsule more complex; penis forked and ribbon-like (as in fig. 68 of *platyscelis*); halteres darker. Eyes of male large, reaching back to ocelli and meeting by about 20 facets, eyes of female normal. 7th sternite of female only slightly emarginate, apical margin of 7th tergite slightly produced and conical. Wing length 2.75-3.0 mm .....**lignicola** Edwards
Uncommon, reared from wood debris. Berks, Cambs, Herts. v-viii.

Subfamily Psectrosciarinae

Another small subfamily, with two genera, *Psectrosciara* Kieffer and *Anapausis* Enderlein. Only the latter, with three species, occurs in Britain.

The subfamily is readily recognized by the numerous macrotrichia on the wing membrane, by the venation and the absence of the false vein between M and CuA; the sperm pump is fused to the genital capsule. *Anapausis* is most easily separated from *Psectrosciara* because the anterior thoracic spiracle is on a separate or partially separated sclerite.

Edwards (1925) placed all three British species plus species of *Rhegmoclema* in *Psectrosciara,* using the presence of macrotrichia on the wing membrane as the main generic character. However, Cook has indicated other characters which give a much better definition of both genus and subfamily and exclude *Rhegmoclema* species.

The British species are easily separable in the male, but females are more difficult and the characters of the female genitalia are less obvious.

Genus **Anapausis** Enderlein

Anapausis Enderlein, 1912: 278-9 (type species *Scatopse soluta* Loew, 1846); Duda, 1928: 45; Cook, 1963: 18; 1965: 7-18; 1981: 318.
Psectrosciara (in part) Edwards, 1925: 270 (not Kieffer, 1911: 192); Collin, 1954: 72.
Aldrovandiella Enderlein, 1912: 265; Duda, 1928: 42; Edwards, 1934: 138; Collin, 1954: 74.

Dark brown or black, laterally compressed, head egg-shaped seen from the front (fig. 44), eyes holoptic and clothed with setae; antennae 9-10 segmented, palpi pointed, more or less equal to labella which have no pseudotracheae. Anterior thoracic spiracle on a separate or partially separate sclerite; metathoracic phragma well developed; posterior tibiae not swollen apically but with well-formed comb (fig. 75), front coxa long but shorter than femur; halteres with a single seta near head. Wings (figs 73-74) with numerous macrotrichia on membrane in at least posterior cells, all veins bear macrotrichia; M_1 always interrupted basally, radial cell broad, with R_{4+5} reaching to about middle of costal margin and strongly curved, section 2 shorter than section 3, false vein between M and CuA absent, M joining R_{4+5} at or basal to its basal curve so that cross vein r-m hardly present. Abdomen with 8 readily identifiable segments, the sterna of segments 6 and 7 may be modified in the males; male genitalia complex (figs 76-78), with a single pair of penis valves and a sclerotized penis; sperm pump closely attached to genital capsule.

This genus is easily recognized by the presence of abundant macrotrichia on the wing membrane and by the wing venation.

Key to species

1 Vein M_2 bent anteriorly at wing margin, macrotrichia present on membrane in most cells (fig. 74); abdomen dull because of presence of dense microtrichia; antennae 10-segmented; male genitalia characteristic (fig. 77) with apical sclerite attached to 8th tergite by pair of slender arms with hole between, penis very distinct, sperm pump large; female with partially divided 7th sternite (fig. 80). A small, dull, brownish species, wing length 1.7-1.8 mm. **talpae** (Verrall) *Cambs, Hunts, Suffolk, Surrey. v-vii.*

— Vein M_2 not bent anteriorly at wing margin, macrotrichia more or less confined to membrane of wing posterior to M_1 (fig. 73); abdomen shining, microtrichia sparse or absent; antennae 10-segmented; male genitalia without two slender arms, female 7th sternite not partially divided; rather larger, more shining 2

2 First tarsal segment of all legs with longitudinal, comb-like rows of transparent peg-like, spiniform setae (fig. 75); male with 6th sternite divided in middle (fig. 76), each half with two lobes, penis not very distinct, sperm pump small, last abdominal tergite with two strong spine-like processes, projecting backwards in relaxed specimens but drawn ventrally in dried ones and very obvious; 8th tergite of female larger (fig. 79), emarginate posteriorly and with a clear 9th tergite fitting into the emargination. Wing length 2.0-2.5 mm. **soluta** (Loew) *Common. Berks, Clwyd, Cumbria, Devon, Dorset, East Sussex, Essex, Gloucs, Hereford & Worcs, Herts, Kent, London, Oxon, Suffolk, Surrey, Warwicks. Scotland: Highland, Strathclyde. Ireland: Co. Dublin. v-ix.*

— First tarsal segments without clear comb-like row of peg-like setae, though all setae rather stout; male with 6th sternite widely emarginate (fig. 78) and with hair tufts at the angles, penis rather obvious, sperm pump very large, last abdominal tergite slightly bilobed beneath, without backwardly directed processes; 8th tergite of female with small triangular projection medially (fig. 81), 9th tergite absent. Wing length 2.1-2.4 mm. ..... **palustris** (Edwards) *Cambs, Norfolk, Suffolk, Surrey. v-vi.*

Subfamily Scatopsinae

This subfamily contains the majority of the species and is probably the most highly evolved. The three essential features are (1) the presence of a false vein in the form of a concave fold between M_2 and CuA_1; (2) the condition of the sperm pump which is not closely connected to the genital capsule but only joined to the base of the penis by the fine, transparent sperm duct; (3) the placing of the anterior thoracic spiracle on a clear, separate sclerite.

Cook recognizes three tribes, one of which, the Swammerdamellini, is not particularly well defined and not very convincing. Its included genera may prove eventually to be better placed in the Scatopsini. However, for the present I am retaining the three tribes.

Key to tribes

1 Wing with macrotrichia on at least vein CuA_2 and often on other veins posterior to R_{4+5} as well (may need high power with tiny specimens); pedicels of halteres without setae; R_{4+5} ending at or before level of middle of wing ..... **Rhegmoclematini** (p.32)

— None of the veins posterior to R_{4+5} bearing macrotrichia; pedicels of halteres with at least one seta each; R_{4+5} various 2

2 Vein R_{4+5} terminating in costa at or before middle of wing; anterior thoracic spiracular plate clearly longer than wide, often a long triangle (figs 105, 113, 120) **Swammerdamellini** (p.35)

— Vein R_{4+5} terminating in costa clearly beyond middle of wing; anterior thoracic spiracular plate not longer than wide, often sub-circular (figs 136, 147) ..... **Scatopsini** (p.37)

Tribe Rhegmoclematini

Two British genera fall here.

Key to genera

1 Antennae with 12 segments; some macrotrichia on both M_1 and M_2; in British species M_1 incomplete at base (fig. 82), R_{4+5} terminating at or before level of middle of wing .... **Rhegmoclema** Enderlein (p.32)

— Antennae with 10 segments; no macrotrichia on either branch of M, CuA_2 with a small number, usually 4-5; M_1 always complete (fig. 101), R_{4+5} terminating at level of middle of wing ..... **Parascatopse** Cook (p.34)

Genus **Rhegmoclema** Enderlein

Rhegmoclema Enderlein, 1912: 276 (type species *R. rufithorax* Enderlein, 1912); Cook, 1955: 241; 1969: 395; 1981: 317; Hutson, 1970: 119; [not Edwards, 1925: 271].

Aldrovandiella Enderlein, 1912:278 (type species *Scatopse halterata* Meigen, 1838); Duda, 1928: 42; Edwards, 1934a: 138; 1934b: 34; Collin, 1954: 74.

Psectrosciara (in part) Edwards, 1925: 270 (not Kieffer, 1911: 192).

Thorax moderately compressed, head oval seen from the front; eyes holoptic and finely pubescent; antennae 12-segmented; palpi oval, hardly more than half as long as labella, which have no pseudotracheae. Thorax dorsally with numerous short setae and larger supra-alar setae; anterior spiracle on separate sclerite; metathoracic phragma well developed. Front coxae quite long, about

0.75 length of femora, posterior tibiae not swollen, all tibiae with comb of stout spines apically, basitarsi with comb of stout spines beneath, especially on hind leg of male. Wing membrane densely clothed with microtrichia and with a small number of macrotrichia in the extreme anal angle; both branches of M and at least CuA_2 with macrotrichia; costa very short, so that section 2 is also short, M_1 incomplete basally, CuA_2 twice bent (fig. 82); pedicel of halteres bare. Abdomen with seven clear pregenital segments in both sexes, males often with reticulate pattern on tergum 1, posterior margin of 6th sternite in both sexes with cluster of short spiniform setae (figs 83-88). Male genitalia in form of a small and compact capsule (figs 89-94), rotated 180°, sometimes with long processes and with one or two pairs of appendages; sperm pump free in abdomen. Female genitalia also capsule-like, cerci apparently fused to 8th tergite, at least one other pair of appendages present (figs 95-100).

Rhegmoclema is a well-defined genus recognized by the 12-segmented antennae, the presence of macrotrichia on both branches of M and on CuA_2 and by the doubly bent CuA_2. It is a genus that has caused trouble in recognition in the past: Edwards (1925), for instance, grouped it with *Anapausis,* placing both in *Psectrosciara* on account of the macrotrichia on the wing membrane. Edwards (1934), Duda (1928) and Collin (1954) used *Aldrovandiella* for the species currently placed in *Rhegmoclema.* Cook (1955) pointed out that there was not really any proper difference between *Aldrovandiella* and *Rhegmoclema,* he therefore synonymized them, using the latter name because it had page precedence.

Apart from difficulties over generic definition, several species were confused by the various authors. This was not helped by the wrong association of the sexes of one species by Duda. However, Collin (1954) and Cook (1969) have resolved this and provided stable names for the European species.

There are six well-defined British species so far recorded. All have good characters in the genitalia of both sexes.

Key to species

1 Front coxae and 1st abdominal sternite yellow or reddish orange, 1st abdominal tergite of male without reticulation 2

— Front coxae and 1st abdominal sternite dark brown or blackish, 1st abdominal tergite of male with reticulate pattern 3

2 CuA_1 with macrotrichia; 6th sternite of male with V-shaped emargination (fig. 83) with groups of spiniform setae each side, 7th sternite broadly emarginate, 7th tergite slightly produced (fig. 89); genital capsule broad and stout (fig. 89), penis conspicuous; female genital capsule (fig. 95) rather compact, margins of 7th tergite and sternite as shown. Wing length 1.0-1.7 mm ..... **coxendix** (Verrall)
Common. Cambs, Cheshire, Cornwall, Derbys, Devon, E. Sussex, Gwynedd, Hants, Hereford & Worcs, Herts, Humberside, Kent, Norfolk, N. Yorks, Oxon, Suffolk, Surrey, W. Sussex. Scotland: Highland. vi-ix.

— CuA_1 apparently with no macrotrichia; male 6th sternite with wavy emargination (fig. 84) and two patches of spiniform setae, 7th sternite highly characteristic (fig. 84) with central, well delineated, largely bare fovea, margin of sternite widely emarginate, 7th tergite as in fig. 90; genital capsule rounded, with two upwardly turned apical processes, shown much foreshortened in fig. 90, centrally are two pairs of clear appendages, penis stout; female genital capsule (fig. 96) with well-developed cerci and a pair of bare, narrow lateral processes, 7th sternite and tergite with apical margins as in the figure. Wing length 1.75-2.1 mm. . ..... **cooki** Hutson
Berks, Humberside, Suffolk, Surrey. vii-viii.

3 Males 4
Females 7

4 Genital capsule posteriorly rounded, without posteriorly directed processes 5

— Genital capsule with posteriorly directed long or hook-like processes 6

5 Genital capsule (fig. 91) with both median and basal constrictions, penis long, appendages small, capsule with median, slightly bifid crest, more obvious in side view; 7th tergite with shallow emargination (fig. 91), 6th sternite broadly emarginate, 7th sternite with deep, broad V-shaped emargination (fig. 85). Wing length 1.5-1.8 mm. ..... **verralli** (Edwards)
Devon, Hants, Kent, Somerset, Suffolk. v-ix.

— Genital capsule (fig. 93) with basal constriction only, rather rounded, penis shorter, appendages small; 7th tergite similar to *verralli;* 6th tergite hardly emarginate; 7th sternite with shallow rounded emargination (fig. 86). Wing length 1.3-1.8 mm. ..... **edwardsi** (Collin)
A Holarctic species. Norfolk. Scotland: Highland. vi.

6 Posterior processes of genital capsule short, broad and upturned (fig. 92), two clear appendages, rather upstanding, the more apical one darkened, penis thin and curved upwards; 7th tergite with wide and fairly deep emargination (fig. 92); 6th sternite rather more emarginate than in *edwardsi,* 7th sternite emarginate as in fig. 87. Wing length 1.5-1.75 mm. ..... **collini** Cook
Cambs, Cumbria, Devon, Gwynedd, Lundy, Norfolk, Oxon, Suffolk, Surrey. Scotland: Grampian, Highland, Strathclyde. vi-viii.

— Posterior processes of genital capsule long, with apices turned out (fig. 94), penis long and upwardly curved, shown foreshortened in figure, only one pair of clear appendages, processes and upturned penis usually visible in dried specimens; 7th tergite somewhat produced posteriorly (fig. 94); 6th sternite not unlike *collini,* 7th sternite (fig. 88) quite characteristic, with central depression not unlike *cooki,* but with finger-like process projecting forwards from its posterior margin, apical margin of sternite with sinuous emargination. Wing length 1.3-1.7 mm. ..... **halteratum** (Meigen)
Scotland: Highland, vii.

7 7th tergite with truncate median process (figs 98, 100) 8

— 7th tergite without this process 9

8 Cerci shorter, in form of a pair of foot-like processes, whole capsule much simpler (fig. 100); 7th tergite less sinuous ..... **halteratum** (Meigen)

— Cerci longer and palpiform (fig. 98), whole capsule more complex, 7th tergite more sinuous ..... **edwardsi** (Collin)

9 Cerci palpiform (fig. 99), 7th tergite shallowly emarginate ..... **collini** Cook

— Cerci represented by pair of points at outer extremities of divided 8th tergite (fig. 97), 7th tergite not emarginate ..... **verralli** (Edwards)

Genus **Parascatopse** Cook

Parascatopse Cook, 1955: 362 (type species *P. wirthi* Cook, 1955); Cook, 1969: 404; 1981: 317

Dull greyish or darker, moderately compressed, very small, sparsely haired species, wings dull with numerous microtrichia. Eyes holoptic, antennae with 10 segments; palpi small, oval, shorter than labella. Thorax with numerous short setae dorsally, anterior spiracle on separate sclerite. Front coxae not particularly large, about 0.75 length of femur, posterior tibiae not swollen, tibiae without conspicuous apical combs of spines, basitarsi without well-formed spine-combs below. Wings with at least 1-6 macrotrichia on CuA_2 (fig. 101), other posterior veins without macrotrichia; costa ending near middle of front margin, section 2 short; M_2 not interrupted basally, CuA_2 sinuous. Male genitalia not rotated (figs 102, 103), with a single median and two lateral pairs of processes, difficult to see in detail, sperm pump free in abdomen. Female genitalia rather simple and of little value for species recognition.

The two very small British species were placed by Edwards (1925) in the all-embracing genus *Scatopse.* The genus *Parascatopse* needs some care in determination as the main character lies in the presence of a few macrotrichia on CuA_2 and generally requires examination by high power of a slide-mounted specimen. Venation and male genital characters can be used for confirmaton.

Records are mainly coastal and in Poland, *P. litorea* has been reared from the soil of saltings, suggesting that both may be salt-marsh species.

Key to species

1 Tibiae broadly whitish at base, tarsi pale, halteres pale brown; penis not forked (fig. 102), male genital appendages elongate, sperm pump relatively large, at least as long as three abdominal segments; 7th tergite broad at base, suddenly becoming much narrower for apical two thirds. Wing length 1.1 mm. ..... **minutissima** (Verrall)
Devon, Sussex. v-viii.

— Tibiae nearly all black, tarsi and halteres brownish black; penis with bifurcate apex (fig. 103), male genital appendages not elongate and difficult to distinguish from one another, sperm pump much shorter, about as long as two abdominal segments; 7th tergite broadly triangular. Wing length 1.0-1.1 mm. ..... **litorea** (Edwards)
Essex, Lancs, Scotland: Highland, Strathclyde. vi-vii.

Tribe Swammerdamellini

Three rather different genera fall here, but they are united by the long anterior thoracic spiracular plate and by the shorter costa. The grouping may well prove to be unnatural.

Key to genera

1 Fork of M exceptionally short and wide, much shorter than stem (fig. 104); section 2 of costal margin no longer than length of R_1; anterior spiracular plate (fig. 105) a long triangle . ..... **Swammerdamella** Enderlein (p.35)

— Fork of M as long as or longer than its stem; section 2 of costal margin longer, about equal to section 1 (figs 112, 119); spiracular plate less elongate, about twice as long as high (figs 113, 120) 2

2 Thorax dull, clothed with dense microtrichia; male with 7th tergite produced posteriorly as narrow spatulate process (fig. 114), penis long and coiled (fig. 116); female with rather abrupt, rounded emargination on posterior margin of 7th sternite (fig. 117) ..... **Coboldia** Melander (p.36)

— Thorax shining and with virtually no microtrichia; 7th tergite of male not produced (fig. 121), penis short and stout (fig. 123); female without posterior emargination on 7th sternite . ..... **Rhexosa** Enderlein (p.37)

Genus **Swammerdamella** Enderlein

Swammerdamella Enderlein, 1912: 277 (type species, *Scatopse brevicornis* Meigen, 1830); Edwards, 1925: 271; Cook, 1956b: 15; 1963: 12; 1972: 625; 1981: 318.

Head and thorax compressed laterally; head (fig. 45) with clypeus rather swollen, eyes holoptic, palpi large and somewhat pointed, larger than labella, rostrum long, nearly half as long as height of eye; antennae with 9 segments, flagellar segments much shorter than wide. Anterior spiracular sclerite a narrow triangle, about twice as long as high, spiracle comparatively small. Wing venation very characteristic (fig. 104), costa short, ending basal to level of middle of wing so that section 2 is very short, less than half length of R_{4+5}, branches of M very short, making the fork triangular, between one third and a quarter length of stem, CuA_2 sinuous; no macrotrichia on any of the posterior veins, membrane covered by small microtrichia; pedicel of halteres with a few setae. Anterior coxae shorter than femora, both rather swollen, tibiae and tarsi of all legs normal, posterior tibiae with row of setae at apex, not forming a close comb. Male abdomen with only six segments visible externally, 7th segment (fig. 108) ring-like and concealed in sixth, and with median tergal process beneath; abdomen of female with 8 obvious segments and two cerci on reduced ninth segment; male genitalia very small, not rotated, with paired appendages, a median short stout penis

and a sclerotized plate beneath, sperm pump rather short, always shorter than the 6th tergite; genitalia more or less fitting within the 7th segment and both lie within 6th.

Despite Cook's statement (1972: 626) to the contrary, this genus was recognized by Edwards (1925) on account of the shortness of both costa and branches of M. It is very distinctive, both because of these characters as well as those of head and spiracular sclerite. There is no definite association of males and females in the rarer species (*acuta*), although both sexes are known of the common species *brevicornis*.

Key to species

1 Sixth tergite of male with broader triangle apically (fig. 106); 7th segment with shorter tergal process (fig. 108); genital capsule (fig. 110) wider and more produced dorsally, with many small differences from *acuta;* female with several rows of setae on 8th segment. Wing length 1.0-1.4 mm. ..... **brevicornis** (Meigen)
Common. Cheshire, Cornwall, Dorset, E. Sussex, Essex, Hants, Herts, Kent, London, Oxon, Suffolk, Surrey. Scotland: Highland. v-ix.

— Sixth tergite of male with acute median process apically (fig. 107); 7th segment with longer tergal process (fig. 109); genital capsule (fig. 111) with shorter arms and not produced dorsally, with many small differences from *brevicornis;* female said by Cook to have only single sparse row of setae on 8th segment. Wing length 1.0-1.25 mm. ..... **acuta** Cook
Herts, Scotland: Tayside. vii-ix.

Genus **Coboldia** Melander

Coboldia Melander, 1916:17-18 (type species *C. formicarum* Melander, 1916 = *Scatopse fuscipes* Meigen, 1830); Cook, 1974: 70; 1981: 319.
Rhaeboza Enderlein, 1936: 55 (type species *Scatopse fuscipes* Meigen, 1830).

Moderately compressed, head more or less egg-shaped seen from the front. Eyes holoptic, antennae with 10 segments, flagellar segments twice as wide as long, palpi oval, larger than labella. Thorax dull, densely clothed with microtrichia between the macrotrichia, supra-alar setae numerous and strong; anterior spiracle on an oval subtriangular plate (fig. 113); legs as in *Rhexosa.* Wing venation (fig. 112) very similar to *Rhexosa,* costa ending more or less at middle of front margin, sections 1 and 2 subequal, about half length of 3; microtrichia on membrane rather dense. Abdomen with microtrichia; 7th tergite of male produced posteriorly into a prominent finger-like lobe, penis very long and coiled; 7th sternite of female with a well-developed central oval emargination.

Separated from *Rhexosa* by the dull thorax and the genital structure of both sexes. The large palpi and subtriangular spiracular plate show its resemblance to *Swammerdamella.* The genus contains a single cosmopolitan species which tends to be anthropophilic. The larvae feed in a wide variety of decaying plant and animal material, such as rotting bulbs and manure. It is also frequently found in numbers around canneries and breweries, where it may be a minor nuisance.

— Thorax dull, whole insect blackish or dark brown, legs sometimes with paler markings; wing venation as in fig. 112; 7th tergite of male quite characteristic (fig. 114), its long finger-like lobe being easily visible without preparation; 7th sternite as in fig. 115; genitalia of rather cage-like construction (fig. 116), penis extraordinarily long, coiled and scaly; 7th sternite of female with oval emargination (fig. 117), genitalia as in fig. 118. Wing length 1.3-2.0 mm. ..... **fuscipes** (Meigen)
Common. Bucks, Cambs, Cheshire, Cornwall, Essex, Gloucs, Hants, Hereford & Worcs, Herts, Kent, London, Lancs, Notts, Oxon, Suffolk, W. Sussex, Wilts, v-xi.

Genus **Rhexosa** Enderlein

Rhexosa Enderlein, 1936: 55 (type species *R. zacheri* Enderlein, 1936 = *R. subnitens* (Verrall) *teste* Cook, 1956a: 4); Cook, 1956a: 1; 1972: 632; 1981: 319.

Moderately compressed, head oval seen from the front. Eyes holoptic, antennae with 10 segments, those of flagellum wider than long, maxillary palpi larger than labella. Thorax shining, microtrichia more or less absent, supra-alar setae numerous and strong, anterior spiracle on long subtriangular sclerite (fig. 120); legs without special characters, tarsi lacking spiniform setae below. Wing venation (fig. 119) very similar to *Coboldia,* costa ending about mid-way along front edge, section 2 rather less than half length of section 3, medial fork quite long, branches divergent, CuA_2 sinuous; membrane with fairly dense microtrichia and no macrotrichia. Abdomen with seven evident segments in both sexes, 8 and 9 forming part of genitalia. Male genitalia a simple capsule, rotated through 180°, with one pair of appendages and a stout sclerotized penis; female with large cerci; male sperm pump fairly small, about one-and-a-half times as long as segment 6.

Very similar to *Coboldia* in many ways, though with shining thorax and distinctive genitalia in both sexes and lacking the long coiled penis of that genus. The relatively short costa and triangular spiracular plate place it in this tribe. There are two British species, both rare; the one being described here as new has a distinctive male 7th abdominal segment and genitalia.

Key to species

1 Thorax shining, without microtrichia on the notum, whole insect blackish, wings milky; male with 7th tergite emarginate as shown (fig. 121) and slightly produced each side, sternite (fig. 122) also emarginate and with two black points; genital capsule (fig. 123) with fairly large penis and two suboval appendages, apex not produced into hairy lobes, vesica reservoir small; female genitalia as in fig. 124, 7th sternite without central emargination. Wing venation as in fig. 119, not unlike *Coboldia* but medial fork rather wider apically. Wing length 1.75-2.0 mm. ..... **subnitens** (Verrall)
Three British records only, two in London (Denmark Hill and Bedford Park), the other Bucks (Slough); larvae recorded from beneath decaying poplar bark in Belgium. iii-vi.

— Thorax shining, without microtrichia on the notal disc, whole insect blackish, though tibiae have some indication of paleness centrally; head and thorax compressed; antennae with ten segments, palpi pointed, larger than labella. Wing venation and anterior spiracular plate as in *subnitens* (figs 119, 120). 7th tergite of male produced centrally (fig. 186), slightly reminiscent of *Coboldia*. 7th sternite deeply emarginate apically (fig. 187), the angles produced and bifid; genital capsule (fig. 188) similar generally to *subnitens,* but penis smaller and appendages with an X-shaped appearance, apex of capsule produced into two upwardly curved, setose lobes; vesica reservoir unusually large (fig. 189). Female not known. Wing length 1.5 mm. ..... **richardsi** Freeman **sp. n.**
Holotype ♂*, Bucks: Wexham Wood, on ragwort, 16.vii.44* (O.W. Richards). *Easily distinguished from* subnitens *by the structure of the male 7th segment and genital capsule. Possibly related to* freyi *(Duda, 1936) from Canary Is which also has a produced 7th tergite though it has haired points laterally, absent in* richardsi. *The single specimen is in the BM(NH), mounted on a slide.*

Tribe Scatopsini

This tribe contains no less than 17 of the 37 so far recorded British species of Scatopsidae. They are placed in seven genera.

Key to genera

1 Thorax broad, scutum as wide as long, subquadrate; wings with dense microtrichia, giving them a pubescent, dull appearance 2
— Thorax clearly longer than wide, usually about 1.5 times as long as wide; wings hyaline, except in *Ferneiella* 3
2 M_1 with a complete supernumerary cross-vein joining it to R_{4+5} (fig. 135); eyes at least touching in both sexes. ..... **Holoplagia** Enderlein (p.39)
— M_1 without a complete supernumerary cross-vein, though there may be a short spur or angle (fig. 125); females dichoptic, eyes separated by width of ocellus, of males more or less touching ..... **Colobostema** Enderlein (p.38)
3 7th sternite in both sexes with cluster of short spiniform setae in addition to usual clothing setae (fig. 167); wings densely clothed with microtrichia, appearing dull and infuscated. ..... **Ferneiella** Cook (p.42)
— No additional spiniform setae on 7th sternite; wings shining and hyaline with sparse microtrichia 4
4 A complete supernumerary cross-vein between R_{4+5} and M_1 (fig. 132) ..... **Cookella** Freeman (p.40)
— At most, vein M_1 with small anteriorly directed spur vein at this point 5
5 Vein M_1 with small anteriorly directed spur vein near base (fig 41); 1st tarsal segment of posterior leg of male shorter than or about same length as second segment ..... **Scatopse** Geoffroy (p.41)
— Vein M_1 lacking this spur vein; 1st posterior tarsal segment of male at least 1.5 times as long as second tarsal segment 6
6 Head, thorax and abdominal tergites all shining, abdominal sternites with dense microtrichia visible under high power, amongst the normal rather dense setae; male with modified 7th tergite (fig. 156), penis large and convoluted, conspicuous in dried specimens (fig. 157) ..... **Reichertella** Enderlein (p.42)
— Head, thorax and abdomen all shining, abdominal sternites largely devoid of microtrichia, setae much more sparse; 7th tergite of male not like this, penis long, narrow and not particularly conspicuous in dried specimens (figs 174-177, 183, 185) ..... **Apiloscatopse** Cook (p.43)

Genus **Colobostema** Enderlein

Colobostema Enderlein, 1926: 140 (type species *C. oldenbergi* Enderlein, 1926 = *Scatopse tristis* Zetterstedt, 1850); Cook, 1956c: 325-332; 1963: 17; 1974: 62; 1981: 318.

Head not compressed, rounded seen from the front; antennae with 10 segments, each flagellar segment about as long as wide; eyes of male said to be holoptic, but in reality just touching at the angle or slightly separated; of female clearly dichoptic and separated by width of ocellus; palpi small and oval, about three-quarters length of labella, rostrum and labella rather small. Thorax stout, not compressed, scutum as wide as long, regular supra-alar setal row absent; anterior spiracle on irregular shaped sclerite, about as wide as long. Legs rather slender, front coxae not enlarged, about half as long as femora, tibiae with a few long strong setae around apex, without comb-like row. Wing venation (fig. 125) with long costa, sections 2 and 3 subequal, M_1 angled near base or with a short spur at this point, CuA_2 sinuous; membrane with no macrotrichia but densely clothed with long microtrichia giving wings a dull brownish or greyish appearance. Abdomen with seven pregenital segments, male genitalia not rotated, capsule somewhat hemispherical with 9th tergite drawn upwards into a bifurcate process (figs 127, 131), penis stout; female genitalia with one pair of appendages on 8th sternite.

A well-defined genus easily recognized from the eyes, broad thorax, wing venation and wing microtrichiation, as well as from the male genitalia. There are two British species, neither of which is very common.

Key to species

1 Tibiae yellowish white on basal half and usually narrowly pale distally; 7th tergite of male like truncated cone (fig. 130), genital capsule (fig. 131) with two long horn-like processes above, main appendages narrower; female 7th tergite (fig. 129) truncate apically. Wing length 2.25-2.5 mm. ..... **nigripenne** (Meigen)
Bucks, Berks, Kent, Hants, Oxon, N. Yorks (under stone with ants Myrmica ruginodis). *Scotland: Grampian. v-vii.*

— Tibiae practically unicolorous, without striking white markings; 7th tergite of male (fig. 126) much broader and notched at sides, genital capsule (fig. 127) with upper part widely forked but without horn-like processes, main appendages wider; 7th tergite of female (fig. 128) rather wider and with small central, rounded emargination. Wing length 1.7-2.75 mm. .... **triste** (Zetterstedt)
Cambs, Oxon, Scillies, Suffolk. iv-v.

Genus **Holoplagia** Enderlein

Holoplagia Enderlein, 1912: 267 (type species *Scatopse transversalis* Enderlein *nec* Loew = *Scatopse lucifuga* Loew, 1870); Cook, 1956d: 610; 1963: 7; 1974: 65; 1981: 318.

Head hardly compressed, slightly taller than wide when seen from the front, eyes more or less holoptic, though sometimes only just touching by the width of one facet; antennae with 10 segments, flagellar segments mostly wider than long but not strongly so; palpi smaller than labella, both rather small. Thorax stout, scutum as wide as long; supra-alar setae present; anterior spiracular sclerite not elongate, more or less equilateral triangular (fig. 136); legs with fairly long tarsi, otherwise with no special characters, front coxae not enlarged, posterior tibiae with row of stronger setae at apex. Wing membrane densely clothed with rather long microtrichia, giving a dull appearance; all species have a distinct and complete cross vein between M_1 and R_{4+5} (fig. 135), section 2 of costal margin subequal to or rather shorter than section 3, vein CuA_1 practically straight, CuA_2 strongly bent towards hind wing margin, joining it at right-angles. Abdomen with seven pregenital segments; genitalia apparently not rotated.

The main diagnostic characters are the stout thorax and strongly microtrichiose wings, combined with the complete supernumerary cross-vein and the strongly bent CuA_2. The two latter features are also present in the new genus *Cookella,* but this is easily distinguished because of its compressed head and thorax, and clear wings. Three species have been recorded from Britain.

It seems that when Enderlein described this genus, he confused Loew's two species *lucifuga* and *transversalis* as has been pointed out by Duda (1928) and also by Cook (1974). Fortunately both species fall into the same genus, although only the latter is British.

Key to species

1 Male with broad median lobe posteriorly on 7th tergite (fig. 137); male genitalia (fig. 138) with short transverse processes and stout, short penis projecting upwards, tip complex: whole genital apparatus large and conspicuous in dried specimens; neither male nor female with spiniform setae on either of sternites 6 or 7; 7th tergite of female with broad, shallow emargination, 7th sternite sinuous with small median, posterior lobe (fig. 139); female genitalia (fig. 140) with 8th sternite produced into two acute sclerotized processes, possibly valvifers. Wings with CuA_1 straight, M_1 and M_2 parallel and both slightly bent forwards. A brownish species, wing length 1.5-1.9 mm. ..... **transversalis** (Loew)
Sometimes found with ants Lasius fuliginosus. *Berks, Cornwall, Hants, Kent, Oxon. v-ix.*

— Males without broad median lobe on 7th tergite, genitalia with two pairs of elongate processes projecting backwards, penis long and narrow; at least 6th sternite in both sexes with cluster of spiniform setae; blackish species 2

2 Male genitalia (fig. 142) with dorsal appendages notched at apex, supporting the ventral pair, ventrally and apically; penis elongate with filamentous apex; 6th and 7th sternites with spiniform setae, 7th tergite truncate, 7th sternite shallowly emarginate; female with spiniform setae on 6th sternite only, 7th tergite broad and slightly emarginate, 7th sternite with straight posterior margin, genitalia as in fig. 141. Wings of female (fig. 135) with oval "bulla" between branches of media, thickly beset with unusually small microtrichia, M_1 and M_2 curved round bulla and divergent apically; CuA_1 straight. Wing length 1.75-2.0 mm. . ..... **bullata** (Edwards)
Rare, not recorded since 1880. Norfolk. vi.

— Male genitalia (fig. 143) with the two appendages applied to each other, the lower pair (shown hatched) the darker, neither notched; penis elongate, apex not filamentous though narrow; 6th sternite with spiniform setae, 7th tergite and sternite as in figs 145, 146, sternite with median protuberance on posterior margin. Female with spiniform setae on 6th sternite; 7th tergite and sternite both shallowly and smoothly emarginate, genitalia as fig. 144. Wings of female without bulla, M_1 and M_2 not curved basally but parallel and curved forwards along their length, slightly divergent apically; CuA_1 slightly bent at apex but much less strongly than in *Cookella*. Wing length 2.2 mm. ..... **richardsi** (Edwards)
Berks, Hants, Somerset (reared from rotting elm), Surrey (reared from rotten beech). iii-vi.

Genus **Cookella** Freeman **gen. nov.**

Holoplagia Enderlein, 1912: 267 (in part); Cook, 1974: 65 (in part). Type species *Scatopse albitarsis* Zetterstedt, 1850: 3408.

Head compressed and oval seen from the front; eyes strongly holoptic, meeting by about five facets width; antennae with ten segments, flagellar segments wider than long; palpi oval and pointed, rather large and bigger than labella. Thorax compressed, scutum about 1.5 times as long as wide, not particularly shining, fairly densely clothed with microtrichia, supra-alar setae present; anterior spiracular sclerite an equilateral triangle as in *Holoplagia* (fig. 136); legs normal, front coxae about 0.75 length of femur, posterior tibia with a well-developed, long row of setae at inner apex. Wings clear, membrane with no macrotrichia; microtrichia small and comparatively sparse, visible only under high power; venation as in fig. 132, resembling *Holoplagia* in the presence of a supernumerary cross-vein between R_{4+5} and M_1, but differing in the strongly curved CuA_1, whilst CuA_2 is less curved and the costa shorter so that section 2 is clearly shorter than section 3. Halteres with 3-4 setae on stem. Abdomen with seven pregenital segments, male genitalia not rotated, with short penis valves and long posterior appendages which are probably gonocoxites, penis elongate and sinuous.

The single species placed here has previously been treated as a species of *Holoplagia,* mainly because of the presence of the supernumerary cross-vein and the somewhat similar male genitalia. However there are so many differences, such as the compressed head and thorax, much smaller and sparser wing microtrichia, larger eye bridge, larger palpi and the wing venational details, that it fits awkwardly into *Holoplagia* and should perhaps be considered as more related to *Scatopse* s. str. and *Reichertella* than to *Colobostema* and *Holoplagia.* A new genus is indicated as the most satisfactory way out of the dilemma. I am pleased to name it in honour of Professor Edwin F. Cook who has done so much to improve our knowledge of the family. He agrees with me that a new genus is needed.

— Black with all tarsi white or sordid white in both sexes; thorax compressed; wings without dense microtrichia, appearing clear, venation as in fig. 132, section 2 of costal margin shorter than section 3, branches of M rather divergent, CuA_1 strongly curved at apex; male genitalia (fig. 133) with long rigid, posteriorly projecting gonocoxites, clothed with long white hairs, very conspicuous in dried specimens; penis long, narrow and sinuous; genital capsule with a tuft of long hairs dorsally; 7th tergite subquadrate and rounded posteriorly, sternite with wide

and deep, triangular emargination; female genital capsule rather small and without free valvifers; female 7th sternite with small, central, V-shaped emargination (fig. 134). Wing length 1.7-1.8 mm. ..... **albitarsis** (Zetterstedt)
Common, Cambs, Glam, Hants, Hereford & Worcs, Herts, Hunts, Kent, London, Norfolk, N. Yorks, Oxon, Surrey. Scotland: Tayside. v-vii.

Genus **Scatopse** Geoffroy

Scatopse Geoffroy, 1762: 544 (type species *Tipula notata* Linnaeus, 1758); Enderlein, 1912: 265; Edwards, 1925: 271 (in part); Cook, 1956d: 594 (in part); 1974: 71; 1981: 318.

Head and thorax moderately compressed, head oval when seen from the front, scutum about 1.5 times as long as wide, whole body shining and devoid of microtrichia. Eyes holoptic, antennae with 10 segments, flagellar segments wider than long, palpi oval, smaller than labella, both of moderate size. Thorax with a row of strong supra-alar setae, anterior spiracular sclerite somewhat irregular but about as long as high (fig. 147). Legs normal except for hind basitarsus of male which is short; front coxae about 0.75 length of femur, apical spines of posterior tibia comb-like. Wings (fig. 41) with small, sparse microtrichia and no macrotrichia on membrane or posterior veins; wings reaching beyond end of abdomen, section 2 of costal margin nearly as long as or longer than section 3, vein M_1 with spur near base, sometimes nearly reaching R_{4+5}. Abdomen with seven clear segments, 7th sternite of male (fig. 150) emarginate and with short, conical process at centre. Male genitalia rotated through 180° and with three pairs of appendages; penis conspicuous, sperm pump rather small for size of insect but with a large reservoir (fig. 151).

Enderlein's restriction of this, the type genus of the family, was not generally recognized until Cook (1971; 1974). Up to that time, most authors, including Cook, had used *Scatopse* to include species now placed in *Reichertella, Ferneiella* and *Apiloscatopse*. The restriction seems logical, especially when the male genital structure is considered.

Key to species

1 Vein R_{4+5} with 3-5 rows of macrotrichia below; male genitalia (fig. 148) with large ventral lobes (gonocoxites) which project beyond the claw-like penis valves (stippled in figure), penis stout and vase-shaped with a pair of long, slender penis valves (stippled); posterior basitarsus of male only 0.5-0.75 length of second segment, female tarsi normal, this basitarsus about 1.25 times length of second segment; female genitalia (fig. 152) with long slender valvifers. A shining black insect with yellow pleural membranes to thorax and first abdominal segment, and a yellow spot above wing base; wing venation (fig. 41) characteristic, section 2 of costal margin 1.25-1.5 times as long as section 3. A large species, wings longer than body, wing length 3.5-4.0 mm ..... **notata** (Linnaeus)
Probably the commonest and most widespread species, breeding in all sorts of decaying vegetable material. It has been transported across the world and is now cosmopolitan. Berks, Cornwall, Dyfed, Hants, Herts, Hereford & Worcs, Kent, London, Lundy, Norfolk, Northumberland, Oxon, Suffolk, Surrey, Sussex. Scotland: Highland, Strathclyde. iv-x.

— Vein R_{4+5} with only one row (or rarely two) of macrotrichia below; gonocoxites not reaching beyond penis valves which are rounded apically (fig. 149), penis with elongate apex; female genitalia (fig. 153) without valvifers. Posterior basitarsus of male almost or quite as long as second segment. Similar in colour to *notata;* section 2 of costal margin of wing slightly shorter than section 3; slightly smaller than *notata.* Wing length 2.0-2.75 mm. ..... **lapponica** Duda
Only British record, 1 ♂ Scotland: Eigg I. Also occurs in northern North America. v.

Genus **Reichertella** Enderlein

Reichertella Enderlein, 1912: 268 (type species *Scatopse femoralis* Enderlein, 1912 *nec* Meigen, 1838 = *Scatopse nigra* Meigen, 1804); Cook, 1971: 6; 1974: 72; 1981: 318.

In general features similar to *Scatopse* as restricted by Cook, but more compressed, head quite narrow seen from the front, differing in complete absence of spur vein near base of M_1 and by posterior basitarsus of male being 1.75 length of second segment, palpi rather pointed. Abdominal sternites with dense microtrichia, though these are not present on the tergites as stated by Cook (1974: 62) in the two British species. In British species, males with modified 7th tergite (fig. 156), genitalia rotated, penis large, conspicuous and convoluted (figs. 157-159), penis valves small, represented by long, narrow processes, gonocoxites absent; dorsal surface of capsule triangular and sclerotized with two long sharp ear-like processes, stated by Cook to be the 10th tergite as the cerci arise from it; sperm pump rather small and with small reservoir, the whole structure not as long as one abdominal segment. Female genitalia (figs. 163-164) with one pair of valvifers and conspicuous cerci.

With the restriction of *Scatopse* s.s. to *S. notata* and its immediate allies, Cook (1971) resurrected Enderlein's genus for the present group of species, which are mostly easily separated from *Scatopse* by the absence of the spur vein and by the genital characters, especially in the male. Cook divided it into two subgenera on characters of both male and female genitalia. Both British species fall into *Reichertella* s.s. The two species have differing wing venation but are united by the male genital structure. Both are entirely black and more or less shining.

Key to species

1 Vein R_{4+5} parallel to costa for most of its length, fairly sharply turned towards costa at its end (fig. 154), costa longer, anal area bigger; 7th male sternite (fig. 160) with wide sinuous emargination, more setose; 7th tergite as in fig. 156, central bar longer than in *pulicaria;* penis long, flat and ribbon-like, appearing knotted centrally (figs 157, 158), a very obvious feature even in dried specimens; female with 7th sternite as in fig. 162, genitalia (fig. 163) longer and with valvifers longer and not transverse. Wing length 2.1-2.6 mm. ..... **geniculata** (Zettersted)
Herts, Humberside, Hunts, Kent, Suffolk, Wilts (congregated in poppy seed-head). Scotland: Highland, Lothian, vi-viii.

— Vein R_{4+5} (fig. 155) more or less convergent gradually on to costa, not sharply turned towards it apically, costa shorter, anal angle more obtuse; 7th sternite of male (fig. 161) with only tiny V-shaped emargination centrally, less setose; 7th tergite similar to *geniculata* but central bar rather shorter; penis shorter, not as obvious (fig. 159), not flattened but swollen apically; female with 7th sternite straight across apically, not emarginate; genitalia (fig. 164) shorter and with valvifers broader, shorter and more or less transverse. Wing length 1.7-1.8 mm. ..... **pulicaria** (Loew)
Cornwall, Norfolk. Ireland: Cork (Clear I.). v-vii.

Genus **Ferneiella** Cook **gen. nov.**

Ferneiella Cook, 1974: 87; 1981: 318 (unavailable name). Type species *Scatopse incompleta* Verrall, 1886.

Head and thorax compressed, though not strikingly so, black, shining and devoid of microtrichia on the disc. Eyes holoptic, antennae with 10 segments, flagellar segments hardly more than half as long as wide; palpi short and ovate, smaller than the not very large labella, rostrum short. Thoracic scutum about 1.5 times as long as its greatest width, supra-alar setae present; anterior spiracular

sclerite small and triangular, about as long as high; setae present on pedicel of halteres; legs with front coxae smaller than usual, posterior basitarsus of male about 1.7 times as long as second segment, spines at apex of posterior tibia comb-like. Wings (figs. 165, 166) with R_{4+5} terminating well beyond middle of front margin, section 2 long; R_{4+5} parallel to costa for most of its length; females with special modifications to media (see key below); CuA_2 with basal half fairly straight then turning sharply towards wing margin. Wing membrane without macrotrichia but densely clothed with microtrichia, giving the wing a dull brownish colour. Abdominal segments densely microtrichiose on both tergites and sternites, 7th sternite (fig. 167) with cluster of spiniform setae at middle of posterior margin in both sexes, similar to those seen on the sterna of *Rhegmoclema*. Female genitalia (figs 169, 170) with a pair of elongate valvifers on 8th sternite placed close together. The male of the type species has genitalia rotated and three pairs of appendages, including cerci, and a stout penis. Duda (1928) states that the male of *brevifurca* has asymmetrical genitalia and only two pairs of appendages. Sperm pump of average size, free in abdomen.

Cook (1974) separated this genus from *Scatopse* and *Apiloscatopse* mainly by the dull, densely microtrichiose wings and the presence of spiniform setae on the 7th sternite. However, the genitalia of the females suggest that the species do form a natural group. Through an oversight, a type species was not designated and the genus was therefore unavailable. Professor Cook is responsible for the above diagnosis and has designated *Scatopse incompleta* Verrall, 1886 as the type species. The genus will now become available as *Ferneiella* Cook *in* Freeman and Lane, 1985. A more complete diagnosis can be found in Cook (1974).

Key to species

1 Male with fork of M subequal to its stem, female with both branches of fork terminating before wing margin and with short spur near base of M_1 (fig. 165) joined by fold to R_{4+5}: no sign of true vein as in *Holoplagia;* male without this spur and with fork branches divergent apically; no signs of bullae near M_1 in either sex. Seventh abdominal sternite broadly and shallowly emarginate in both sexes. Male genitalia (fig. 168) with curved, stout penis, pair of bare, acute penis valves, and setose gonocoxites and cerci. Female genitalia (fig. 169) with two very characteristic, long, apically enlarged valvifers on 8th sternite, which appears to be split into four; cerci large. A dark blackish brown species, wing length 1.9-2.1 mm. . . . . **incompleta** (Verrall)
Hants, Hunts, Suffolk. v-vi.

— Male and female with fork of M shorter than stem (according to Duda's figures), branches reaching wing margin in both sexes; female with microtrichiose bullae on each side of M_1 (fig. 166) and no sign of spur or fold from M_1 to R_{4+5}; wing narrower and M more posterior than usual. Male genitalia said to have two pairs of appendages and curved penis with blackened end; female genitalia (fig. 170) with asymmetrically spatulate valvifers. Wing length 2.0 mm. . . . . **brevifurca** (Enderlein)
Very rare. Norfolk (1 ♀). v.

Genus **Apiloscatopse** Cook

Apiloscatopse Cook, 1974: 90 (type species *Scatopse scutellata* Loew, 1846); Cook, 1981: 318.

Head and thorax moderately compressed, head oval seen from the front (fig. 43); body black, dark brown or partially yellow, most parts devoid of microtrichia and hence shining. Eyes holoptic in both sexes, antennae with 10 segments, flagellar segments wider than long, palpi small, about half as long as labella. Anterior spiracular sclerite small, about as high as long, similar to *Scatopse* (fig. 147), supra-alar setae present. Front coxae about 0.7 length of femora; tibiae of front and middle legs in male often with a short spine-like or thumb-like process apically, posterior tibia with clear comb-like row of stronger setae at apex, posterior basitarsus about 1.5 times as long as second segment. Posterior veins of wing and membrane devoid of macrotrichia, latter with obvious

microtrichia; costa (figs. 171, 173) extending for at least 0.75 length of front margin, CuA_2 gently curved, all veins reaching margin. Abdomen with seven pregenital segments in both sexes; 7th tergite of male frequently asymmetrical, genitalia rotated, with clear and usually sclerotized gonocoxites; penis valves fused at the ends around the aedeagal aperture, penis elongate, bowed ventrally (true dorsal), often bifid, and protruding through the aedeagal aperture (figs 174, 175). Male genital capsule not compact and penis based joined to it by a double series of sclerites (e.g. figs 183, 185); sperm pump fairly large but reservoir not as large as in *Scatopse*. Female genitalia with 8th sternite and often 9th as well, bearing pairs of valvifers (figs 180-182).

This genus was erected by Cook to receive those species formerly placed in *Scatopse* but which remained when that genus was restricted and *Ferneiella* and *Reichertella* were split off. From the male genital structure it is clearly a good genus, containing related species. Five species have been recorded from Britain.

Key to species

1 Thorax mainly yellow, first two antennal segments yellow, abdomen yellow with dark markings on tergites and some sternites, legs yellow, tibiae darker apically; tibiae of front and mid legs of male with thumb-like apical processes. Wings of male with stem of M fork angled (fig. 171), in female more smoothly rounded (fig. 172); all three sections of costal margin approximately subequal. Seventh abdominal sternite and tergite of male symmetrical, the tergite (fig. 178) emarginate, sides of emargination pigmented but not centre, sternite shallowly emarginate. Male genitalia (fig. 174) with gonocoxites rather "molar-like", heavily pigmented, penis not bifurcate, elongate and coiled apically. Female genitalia (fig. 180) with 8th sternite narrow and carrying two elongate valvifers side by side; 9th sternite not easily seen, but carrying two short, wide valvifers; 7th tergite and sternite both with shallow, rounded emarginations. Wing length 3.25-4.0 mm. ..... **flavicollis** (Meigen)
A large and distinctive species, often abundant on leaves of trees in woods in autumn and at ivy blossom in company with A. picea. *Berks, Cambs, Cumbria, E. Sussex, Glam, Gloucs, Gwent, Gwynedd, Hereford & Worcs, Herts, Kent, Oxon, Salop, Staffs, Surrey. Scotland: Highland. ix-x.*

— Thorax with scutum mainly black, yellow colour confined to parts of pleura, margin of scutellum and in some species a spot above the wing base; antennae all black; legs with femora and tibiae darkened at least apically and sometimes more extensively; wings (fig. 173) with stem of M fork smoothly curved in both sexes, section 1 of costa shorter than section 2 .. 2

2 Penis not bifurcate; 7th abdominal tergite of male strongly asymmetrical (fig. 179), 9th tergite (actually ventral because of torsion) with conspicuous finger-like process (fig. 175), visible in dried specimen; female genitalia (figs 181, 182) with 8th sternite carrying triangular or parallel-sided valvifers. 3

— Penis strongly bifurcate, sometimes visible in dried specimens as two projecting whiplash-like processes (figs 183, 185); 7th tergite of male symmetrical or only slightly asymmetrical, 9th tergite without finger-like process; female genitalia (fig. 184) without distinct valvifers on 8th sternites which are in form of broadly rounded lobes. 4

3 Scutellum light or dark brownish, thoracic pleura pale, basal abdominal sternite pale, basal halves of femora and nearly all of tibiae yellowish, halteres yellow; tibiae of males simple, without spine or process at apex. Seventh abdominal tergite of male strongly asymmetrical (fig. 179), produced farther on left, 7th sternite also asymmetrical but produced farther on right, with nipple-like process on left; 9th tergite with conspicuous finger-like process; gonocoxites with two posterior and one sharper, dorsally directed, lobes; penis not bifurcate nor twisted, with subapical hook (figs 175, 176). Female genitalia (fig. 181) with one pair of parallel-sided, apically rounded valvifers, obscuring tiny, seta-bearing valvifers of 9th sternite. Wing length 2.5-3.0 mm. ..... **picea** (Meigen)
Common on leaves in woods and at ivy blossom in autumn, often with A. flavicollis, scutellata *and* Scatopse notata. *Cornwall, Cheshire, E. Sussex, Gwynedd, Herts, Kent, Salop, Surrey. ix-x.*

— Scutellum more conspicuously yellow, femora practically all black, tibiae with about apical half black. Closely resembling *picea* in general features, 7th tergite and sternite of male

similar, 9th tergite also with conspicuous finger-like process. Distinguished in male by gonocoxites which have only single lobe and by penis (fig. 177) which is shorter and, after a kink, terminates in flat plate, thickly spinose on one side. Female genitalia (fig. 182) with triangular valvifers on 8th sternite, valvifers absent on 9th sternite. Wing length 2.5-3.0 mm. ..... **scutellata** (Loew)
Another autumnal species, found swarming on leaves and at ivy, generally with A. picea, *treated by Edwards as a variety of* picea. Cumbria, Gwynedd, Herts, Kent, Surrey. ix-x.

4 Penis shorter (fig. 183), with longer, upper branch pointed; shorter, lower one blunt-ended, recurved and hooked and not usually visible without dissection; ejaculatory duct ends in lower branch; gonocoxites stouter (slightly foreshortened in figure); 7th tergite and sternite of male symmetrical, tergite not emarginate, sternite shallowly so; anterior and middle tibiae of male produced at apex into short spinose spine. Female genitalia with 8th sternite (fig. 184) consisting of two broadly rounded lobes with no distinct valvifers, 9th sternite with small, broad, lobe-like valvifers. Head, thorax and abdomen brown or blackish brown, thoracic pleura with yellow band along upper edge, first abdominal sternite whitish, halteres white. Legs blackish, tibiae yellowish brown on basal halves. Wing venation as in *picea,* wing length 2.4-4.0 mm ..... **flavocincta** (Duda)
Very rare, only three British records. Cambs, Suffolk. ix.

— Penis much longer (fig. 185), clearly visible in dried specimens, longer branch pointed, shorter one ending in cup-like opening of ejaculatory duct; gonocoxites more pincer-like and narrower. [A Corsican specimen has shorter penis branches and may be a different species or else the penis length is variable.] 7th tergite very slightly asymmetrical, left side the more produced, shallowly emarginate, laterally a nipple-like process each side; 7th sternite with wide and deep, rounded emargination. Male anterior and middle tibiae ending in short stout spine. Females from Corsica with above male have genitalia very like *flavocincta* (fig. 184) but with valvifers of 9th segment rather longer (no British females known). Body very dark brown, thoracic pleura yellowish along upper margin, scutum with yellow spot above wing base; basal abdominal sternite yellowish; legs dark, tibiae pale on basal halves or more. Wing venation as in *picea,* wing length 3.5 mm. ..... **bifilata** (Walker)
Very rare. Hereford & Worcs (2♂), type locality "Ireland" (2 specimens in National Museum of Ireland). ix.

References

ANDERSON, J. 1919. Saint Mark's fly (*Bibio marci*) larvae attacking *Polyanthus* roots. *Entomologist's Rec. J. Var.* **31:** 206.

BEEKEY, C.E. 1938. The immature and adult stages of a new species of *Scatopse* from Maine. (Diptera: Scatopsidae). *Ent. News* **49:** 151-154.

BOVIEN, P. 1935: The larval stages of *Scatopse* (Diptera Nematocera). *Vidensk. Meddr dansk naturh. Foren.* **99:** 33-43.

BRINDLE, A. 1962. Taxonomic notes on the larvae of British Diptera. 6 — The family Bibionidae. *Entomologist* **1962:** 22-26.

BRYCE, D. 1953. Notes on the life history of *Bibio leucopterus. Entomologist's mon. Mag.* **89:** 156-157.

CAMERON, A. E. 1936. Insect and other pests of 1935. *Trans. Highl. agric. Soc. Scotl.* **1936:** 82-121.

CARPENTER, G. H. 1920. Injurious insects etc. in Ireland during 1916, 1917, 1918. *Econ. Proc. R. Dublin Soc.* **2:** 259-272.

CLEMENTS, R. O. 1982. Sampling and extraction techniques for collecting invertebrates from grassland. *Entomologist's mon. Mag.* **118:** 133-142.

COLLIN, J. E. 1954. Notes on some British Scatopsidae (Diptera). *J. Soc. Br. Ent.* **5:** 72-75.

COLLINGE, W. E. 1913. Seventh Annual Report of Hon. Consulting Biologist. *J. Land Agents Soc.* [Abstract in *Rev. appl. Biol. 1913.*]

COOK, E. F. 1955a. A contribution toward a monograph of the family Scatopsidae (Diptera). Part I. A revision of the genus *Rhegmoclema* Enderlein (= *Aldrovandiella* Enderlein) with particular reference to the North American species. *Ann. ent. Soc. Am.* **48:** 240-251.

COOK, E. F. 1955b. Part II, the genera *Rhegmoclemina* Enderlein, *Parascatopse* n.g., and a new species of *Rhegmoclema. Ann.ent.Soc.Am.* **48:** 351-364.

COOK, E.F. 1956a. Part III. The genus *Rhexosa*. *Ann.ent.Soc.Am.* **49:** 1-12.
COOK, E.F. 1956b. Part IV. The genus *Swammerdamella* Enderlein. *Ann. ent. Soc. Am.* **49:** 15-29.
COOK, E.F. 1956c. Part V. The genus *Colobostema* Enderlein. *Ann. ent. Soc. Am.* **49:** 325-332.
COOK, E. F. 1956d. Part VI. The genera *Scatopse* Geoffroy and *Holoplagia* Enderlein. *Ann. ent. Soc. Am.* **49:** 593-611.
COOK, E. F. 1963. Guide to the insects of Connecticut. Part VI. The Diptera or true flies. 8 — Scatopsidae and Hyperoscelidae. *Bull. Conn. St. geol. nat. Hist. Surv.* **93:** 1-37.
COOK, E. F. 1965. A contribution toward a monograph of the Scatopsidae (Diptera). Part VIII. The genus *Anapausis*. *Ann. ent. Soc. Am.* **58:** 7-18.
COOK, E. F. 1969. A synopsis of the Scatopsidae of the Palaearctic. Part I. Rhegmoclematini. *J. nat. Hist.* **3:** 393-407.
COOK, E. F. 1972. Part II. Swammerdamellini. *J. nat. Hist.* **6:** 625-634.
COOK, E. F. 1974. Part III. The Scatopsini. *J. nat. Hist.* **8:** 61-100.
COOK, E. F. 1975. A reconsideration of the nearctic *Rhexosa* (Diptera: Scatopsidae). *Pan-Pacif. Ent.* **51:** 62-75.
COOK, E. F. 1981. Scatopsidae *in* Manual of Nearctic Diptera. *Ed.* McAlpine, J. F. *et al.* Monogr. no. 27 *Res. Branch Agric. Canada* **1:** 313-319.
DUDA, O. 1928. Scatopsidae, *in* Lindner, E., *Die Fliegen der palaearktischen Region.* 2 (1). fasc. **5:** 1-62.
DUDA, O. 1930. Bibionidae, *in* Lindner, E., *Die Fliegen der palaearktischen Region* 2 (1). fasc. **4:** 1-75.
DUDA, O. 1936. Family Scatopsidae *in* Frey, R., 1935-7, Die Dipteren Fauna der Kanarischen Inseln und ihre Probleme. *Commentat. biol.* **6:** 18-19.
DUFFIELD, C. A.W. 1930. Entomological Department. *Rep. S.-East agric. Coll. Wye* **1929-30:** 68-78.
EDWARDS, E.E. 1941. The fever fly *Dilophus febrilis* L., and methods for control of its larvae in cultivated lawns. *Ann. appl. Biol.* **28:** 34-38.
EDWARDS, F. W. 1925. A synopsis of British Bibionidae and Scatopsidae. *Ann. appl. Biol.* **12:** 263-275.
EDWARDS, F. W. 1934a. Two species of Scatopsidae (Diptera) new to Britain. *Entomologist's mon. Mag.* **70:** 138-140.
EDWARDS, F. W. 1934b. *Aldrovandiella winthemi* Duda in Scotland: a Scatopsid (Dipt.) new to the British Isles. *J. Soc. Br. Ent.* **1:** 34-35.
ENDERLEIN, G. 1912. Zur Kenntnis der Zygophthalmem. Über die Gruppierung der Sciariden und Scatopsiden. *Zool. Anz.* **40:** 261-282.
ENDERLEIN, G. 1926. Zur Kenntnis der Scatopsiden. *Zool. Anz.* **68:** 137-142.
ENDERLEIN, G. 1936. Diptera *in* Tierwelt Mitteleuropas 6: Insekten 3: 1-259.
EVANS, W. 1912. Food of the common partridge. *Scot. Nat.* 1912: 278-279.
FABRICIUS, J. C. 1775. *Systema entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus.* Flensburg & Leipzig.
FREE, J. B. 1970. *Insect pollination of crops.* London.
GEOFFROY, E.L. 1762. *Histoire abrégée des insectes qui se trouvent aux environs de Paris.* **2:** 690 pp. Paris.
GILLANDERS, A. T. 1908. *Forest Entomology.* London
HALIDAY, A. H. 1833. Catalogue of Diptera occurring about Holywood in Downshire. *Ent. Mag. (London)* **1:** 147-180.
HARDY, D. E. 1958. Guide to the insects of Connecticut. Part VI. The Diptera or true flies. 6 — Family Bibionidae. *Bull. Conn. St. geol. nat. Hist. Surv.* **87:** 5-45.
HARDY, D. E. 1981. Bibionidae *in* Manual of Nearctic Diptera. *Ed.* McAlpine, J. F. *et al.* Monogr. no. 27 *Res. Branch Agric. Canada* **1:** 217-222.
HARRIS, M. 1780. *An exposition of English insects with curious observations and remarks wherein each insect is particularly described, its parts and properties considered, the different sexes distinguished and the natural history faithfully related.* London.
HENNIG, W. 1948. Die Larvenformen der Dipteren. 1, 185 pp. Berlin.
H.M.S.O. 1965. Cereal pests. *Bull. Minist. Agric. Fish. Fd, London.* **186.**
HUTSON, A. M. 1970. Corrections and additions to the list of British Nematocera (Diptera) since Kloet and Hincks' "A check list of British insects" (1945). Part 2, Scatopsidae. *Entomologist's Gaz.* **21:** 117-123.
HUTSON, A. M. 1973. *Scatopse lapponica* Duda, new to Britain, with notes and records of other British species of Scatopsidae (Dipt.). *Entomologist's mon. Mag.* **108:** 200-201.

KEILIN, D. & TATE, P. 1940. The early stages of the families Trichoceridae and Anisopodidae (= Rhyphidae) (Diptera Nematocera). *Trans. R. ent. Soc. Lond.* **90:** 39-62.
KIEFFER, J. J. 1912. Beschreibung neuer Sciariden von den Seychellen-Inseln. *Trans. Linn. Soc. Lond. (Zool.)* **15:** 192-194.
KLOET, G. S. & HINCKS. W. D. 1945. *A check list of British Insects.* 483 pp. Arbroath.
KLOET, G.S. & HINCKS, W. D. 1976. A check list of British Insects, 2nd ed. *Handbk Ident. Br. Insects* **11** (5): 1-139.
LAURENCE, B.R. 1953. The larva of *Ectaetia* (Dipt., Scatopsidae). *Entomologist's mon. Mag.* **89:** 204-205.
LINNAEUS, C. 1758. *Systema naturae per regna tria naturae.* Ed. 10, **1.** 824 pp. Holmiae.
LINNAEUS, C. 1767. *Systema naturae per regna tria naturae.* Ed. 12 (rev.), **1.** Holmiae.
LOEW, H. 1846. Fragmente zur Kenntniss der europäischen Arten einiger Dipterengattungen. *Linn. ent.* **1:** 319-530.
LOEW, H. 1870. Bemerkungen über einige *Scatopse*-Arten. *Zeiten. ges. Natur. Halle* **35:** 1-6.
LOEW, H., 1871. *Beschreibung europäischen Dipteren. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insecten, von Johann Wilhelm Meigen.* **2.** Halle.
LOVIBOND, B. 1938. The fever fly, *Dilophus febrilis. J. Board Greenkeeping Res.* **5:** 271-273.
LUNDSTRÖM, C. 1913. Neue oder wenig bekannte paläarktische Bibioniden. *Ann. Mus. nat. Hung.* **10:** 388-397.
LYALL, E. 1929. The larva and pupa of *Scatopse fuscipes* Mg. and a comparison of the known species of Scatopsid larvae. *Ann. appl. Biol.* **16:** 630-638.
MEADE, A. B. & COOKE, E. F. 1961. Notes on the biology of *Scatopse fuscipes* (Meigen) (Diptera: Scatopsidae). *Ent. News* **72:** 13-18.
MEIGEN, J. W. 1803. Versuch einer neuer GattungsEintheilung der europäischen zweiflügeligen Insecten. *Magazin Insektenk (Illiger)* **2:** 259-281.
MEIGEN, J. W. 1804. Klassifikation und Beschreibung der europäischen zweiflügeligen Insekten (Diptera Linn.) **1:** Braunschweig.
MEIGEN, J. W. 1818, 1830, 1838. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. **I, VI, VII.** Aachen and Hamm.
MELANDER, A. L. 1916. The dipterous family Scatopsidae. *State Coll. Wash. agr. exp. Sta. Bull.* **130:** 1-21.
MORRIS, H. M. 1917. The larval and pupal stages of *Bibio johannis* L. *Ann. appl. Biol.* **4:** 91-114.
MORRIS, H. M. 1918. The larval and pupal stages of *Scatopse notata* L. *Ann. appl. Biol.* **55:** 102-111.
MORRIS, H. M. 1921. The larval and pupal stages of the Bibionidae. *Bull ent. Res.* **12:** 221-232.
MORRIS, H. M. 1922. The larval and pupal stages of the Bibionidae — Part II. *Bull. ent. Res.* **13:** 189-195.
OLDROYD, H. 1970a. Diptera. Introduction and key to families, 3rd ed. *Handbk Ident. Br. Insects* **9** (1): 1-104.
OLDROYD, H. 1970b. *Collecting, preserving and studying insects.* 2nd Ed. 366 pp. London.
PARMENTER, L. 1941. *Bibio marci* L. captured by garden warbler. *Entomologist's mon. Mag.* **77:** 153.
PORT, C. M. & FRENCH, N. F. 1984. Damage to spring barley by larvae of *Dilophus febrilis* (L.). *Pl. Path.* **33:** 133-134.
RICHARDS, O. W. 1934. Some breeding records of Diptera. *J. Soc. Br. Ent.* **1:** 2-3.
RICHARDS, O. W. & DAVIES, R. G. 1977. *A general textbook of entomology.* 10th ed. London.
SALT, G. & HOLLICK, F. S. J. 1944. Studies of wireworm population in a census of wireworms in pasture. *Ann. appl. Biol.* **31:** 53-64.
SAVAGE, M. J. 1977. Damage to cereals by larvae of *Bibio johannis* L. *Ann. appl. Biol.* **4:** 91-108.
SHAW, M. W., OSBORNE, P., NEWBOLD, J. W. & HOLMES, S.J.I. 1977. Observations and comments on pests of minor or unknown importance, of intermittent occurrence or as vectors of pathogens of cereals and grasses. *Proc. Symp. Problems Pest & Disease Contr. N. Brit. Dundee.* 21-25.
SZADZIEWSKI, R. 1979. The immature stages of two halobiont Diptera, *Dicranomyia sera* (Walker) (Limoniidae) and *Parascatopse litorea* (Edwards) (Scatopsidae). *Polskie Pismo ent.* **49:** 385-388.
THEOBALD, F. V. 1908. Fever flies (Bibionidae) in hop roots, larvae causing severe damage. *Jl S.-east agric. Coll. Wye* **17:** 165.
THEOBALD, F.V. 1909a. Fever flies (Bibionidae) damaging hops, larvae eating through crowns. *Jl S.-east agric. Coll. Wye* **18:** 159-160.

THEOBALD, F.V. 1913. Hops attacked by *Bibio hortulanus* larvae. *Jl S.-east agric. Coll. Wye* **22:** 267.
TONNOIR, A.L. 1926. Larve et nymphe de *Scatopse subnitens* Verr. (Dipt.). *Bull. Annls Soc. ent. Belg.* **66:** 353-356.
VERRALL, G. H. 1869. Description of a new species of *Bibio*. *Entomologist's mon. Mag.* **5:** 268-270.
VERRALL, G. H. 1886. A hundred new British species of Diptera. *Entomologist's mon. Mag.* **22:** 179-182.
VERRALL, G. H. 1912. Another hundred new British species of Diptera. *Entomologist's mon. Mag. (n.s.)* **23:** 21-22.
VIMMER, A. 1935. *Aspistes berolinensis* Mg. V. Ceskoslovenske Republice (Bibion. Dipt.). *Cas. csl. Spol. ent.* **32:** 58-59.
WALKER, F. 1856. *Insecta britannica, Diptera III.* London.
WILSON, H.F. 1915. Minor insect pests. 2nd Biennial Crop Pest and Horticultural Rep. 1913-1914, Oregon agric. exp. St. Corvallis : 195-202.
ZETTERSTEDT, J. W. 1850. *Diptera Scandinaviae disposita et descripta.* **IX,** pp. 3367-3710. Lundae.

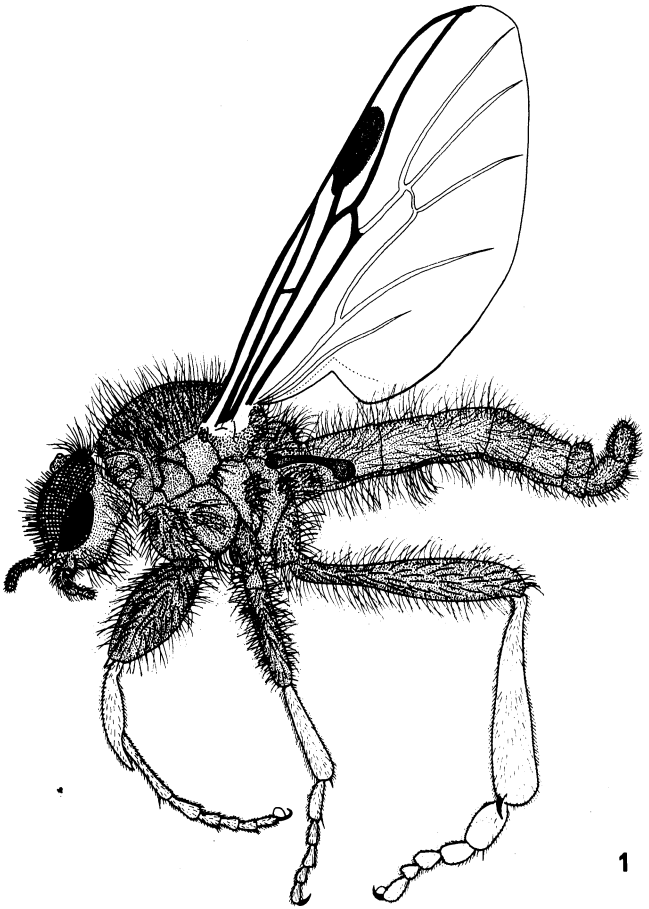
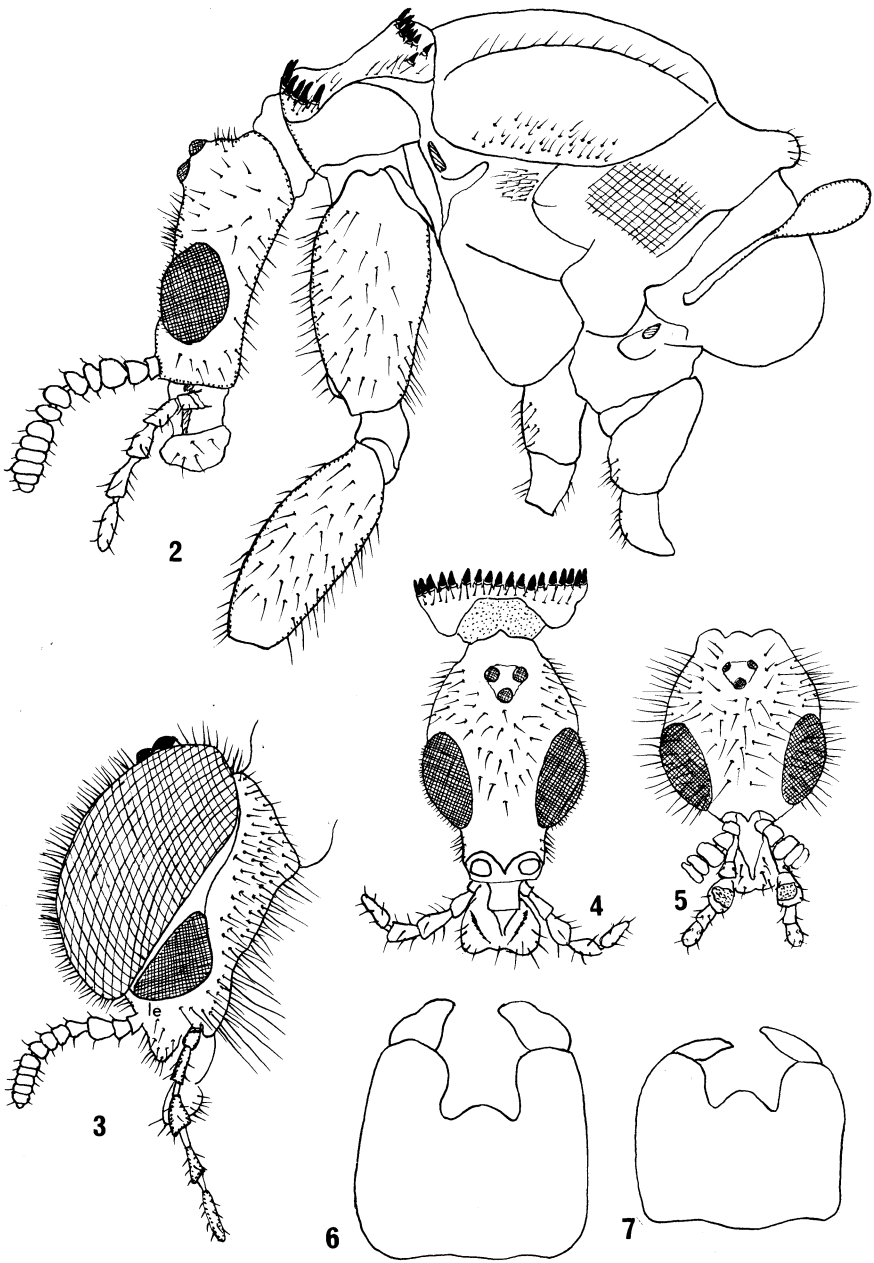
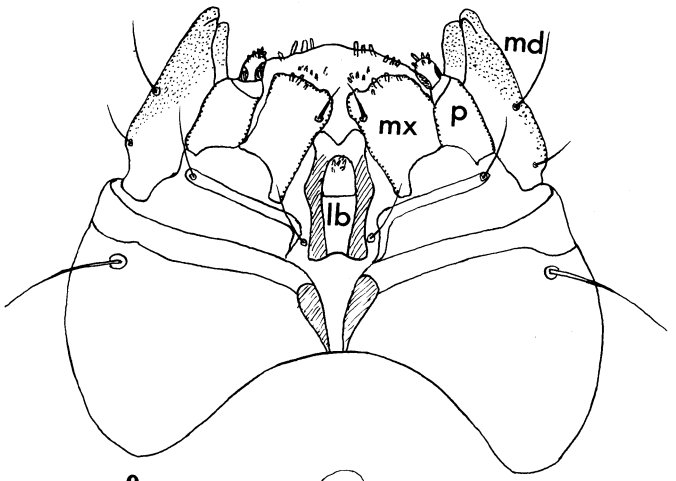
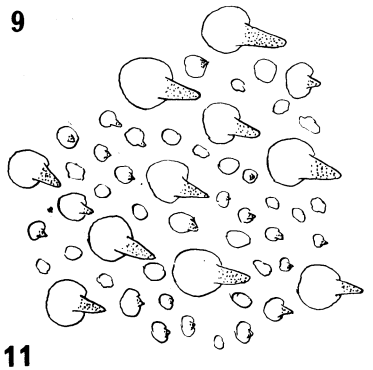


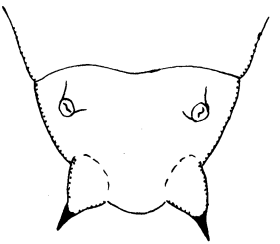
Fig. 1. *Bibio johannis* male.

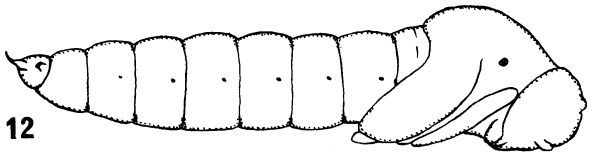


Figs. 2-7. *Dilophus.* 2, *D. febrilis* lateral view of head and thorax of female, slightly diagrammatic, front femur only shown. 3, same, lateral view of head of male, interfacetal hairs shown on margin only. 4, *D. femoratus,* head of female from front, showing first row of prothoracic spines as well, antennae omitted. 5, *D. humeralis* head from the front, basal segments of antennae shown. 6, *D. femoratus* ventral view of male genitalia. 7, *D. humeralis,* same; *le,* lower division of male eye.

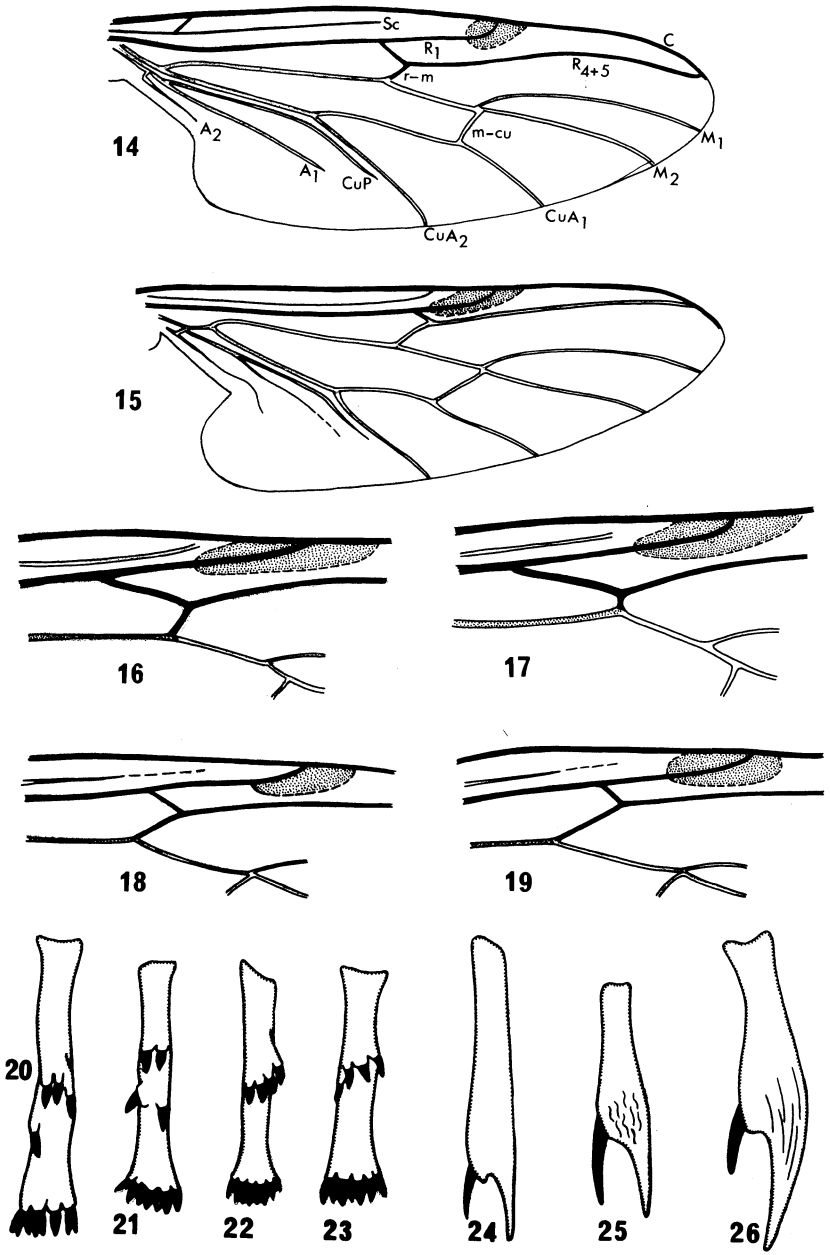




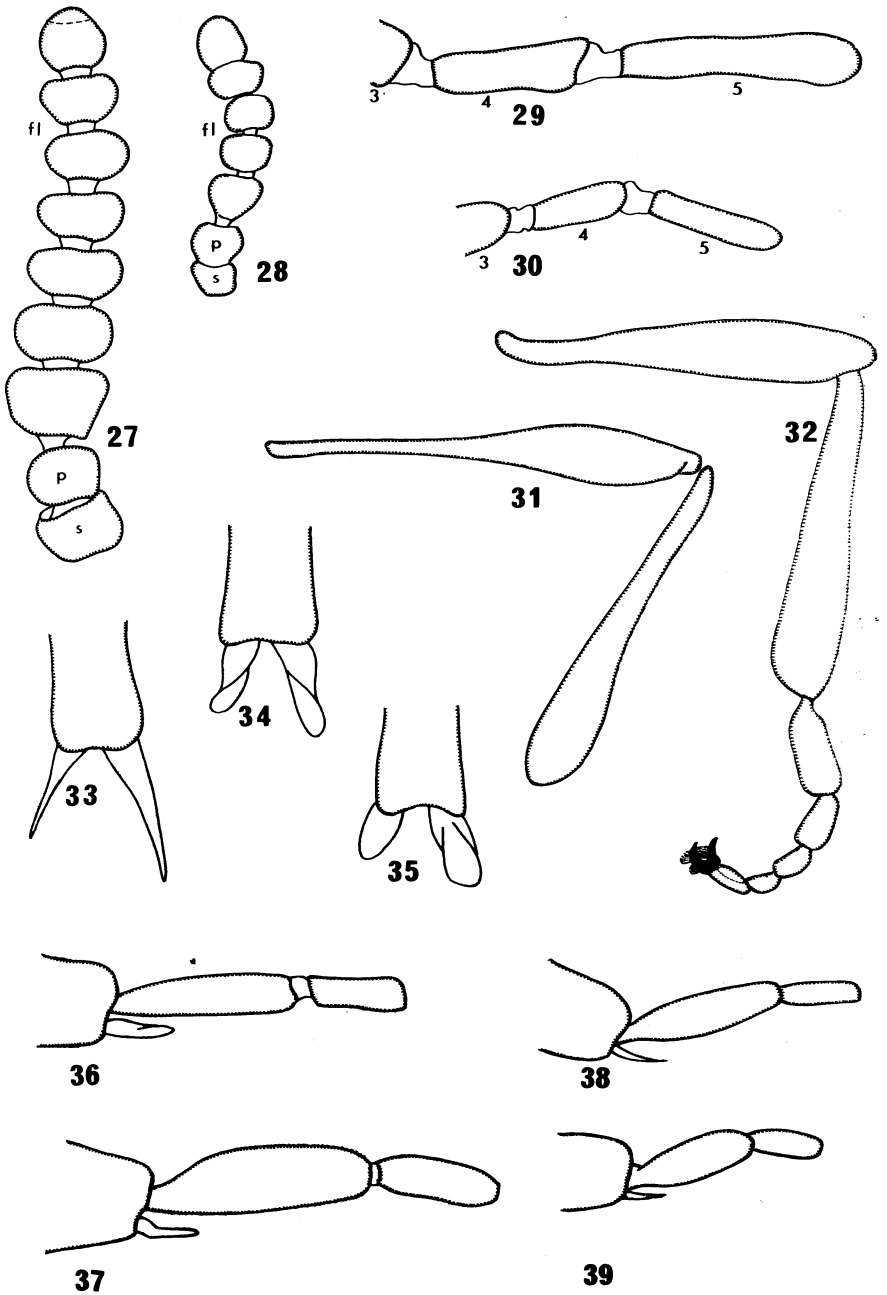




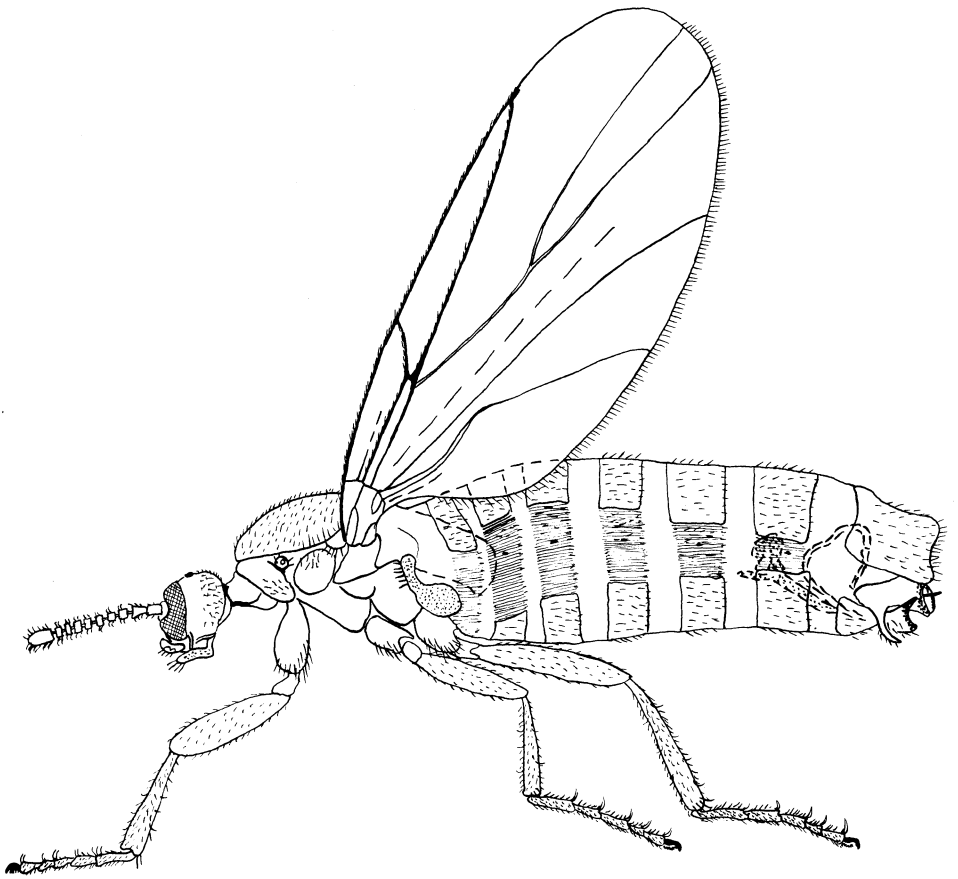
Figs. 8-13. Bibionidae, larvae and pupa. 8, *Bibio marci,* larva in lateral aspect. 9, same, ventral aspect of larval head. 10, *Dilophus febrilis,* larval labium. 11, *B. marci,* portion of dorsal cuticle of 4th segment of larva. 12, same, pupa in lateral aspect. 13, same, apex of abdomen of male pupa from above. *lb,* labium. *md,* mandible. *mx,* maxilla. *p,* maxillary palp.



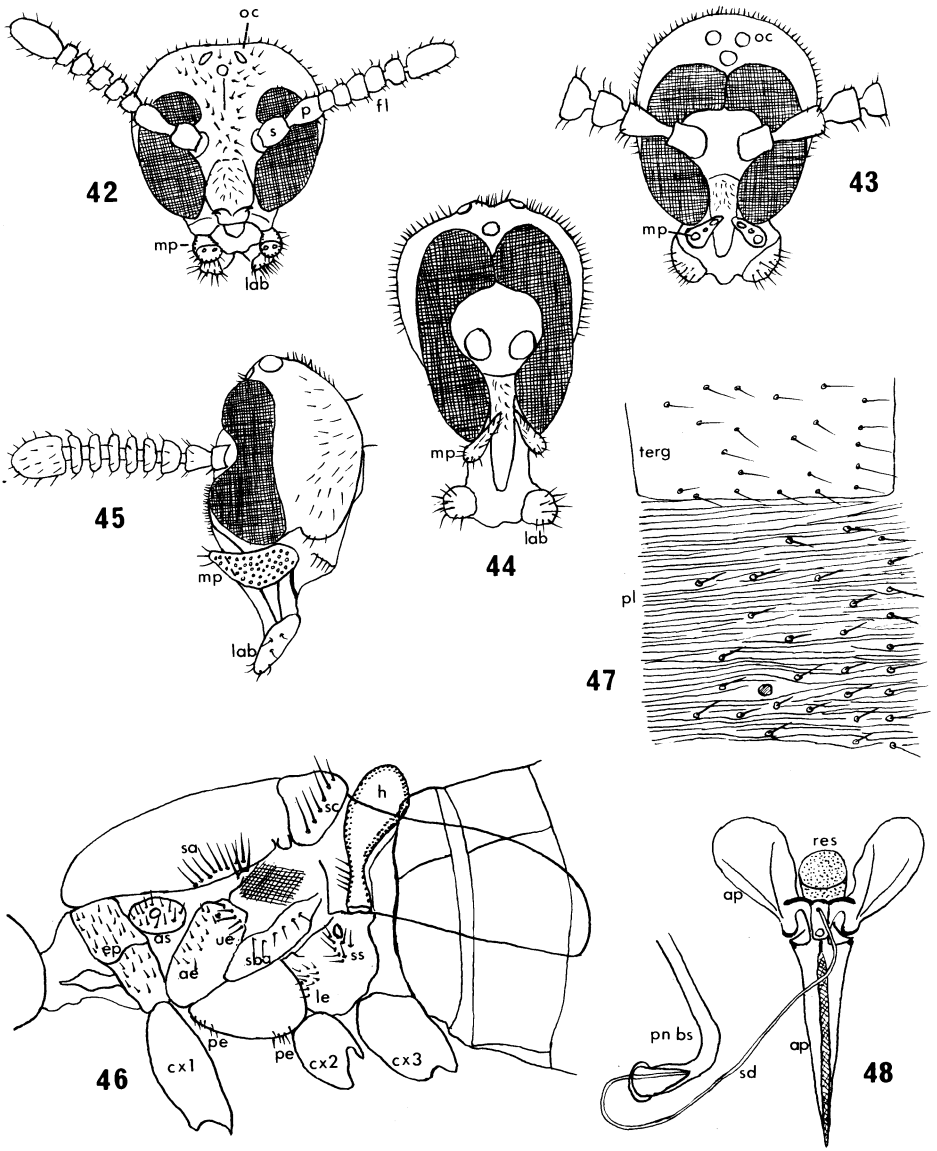
Figs. 14-26. Bibionidae, wings and front tibiae. 14, *Bibio venosus.* 15, *Dilophus febrilis.* 16, *B. marci,* part of wing to show ratio of r-m to base of R_{4+5}. 17, *B. hortulanus,* same. 18, *B. clavipes,* same, and stigma size. 19, *B. lepidus,* same. 20, *D. febrilis,* near spines shown black, further ones dotted. 21, *D. bispinosus,* same. 22. *D. femoratus,* same. 23, *D. humeralis,* same. 24, *B. venosus,* articulated spur black, outer spine unshaded. 25, *B. leucopterus,* same. 26. *B. marci,* same. Clothing hairs omitted on tibiae.



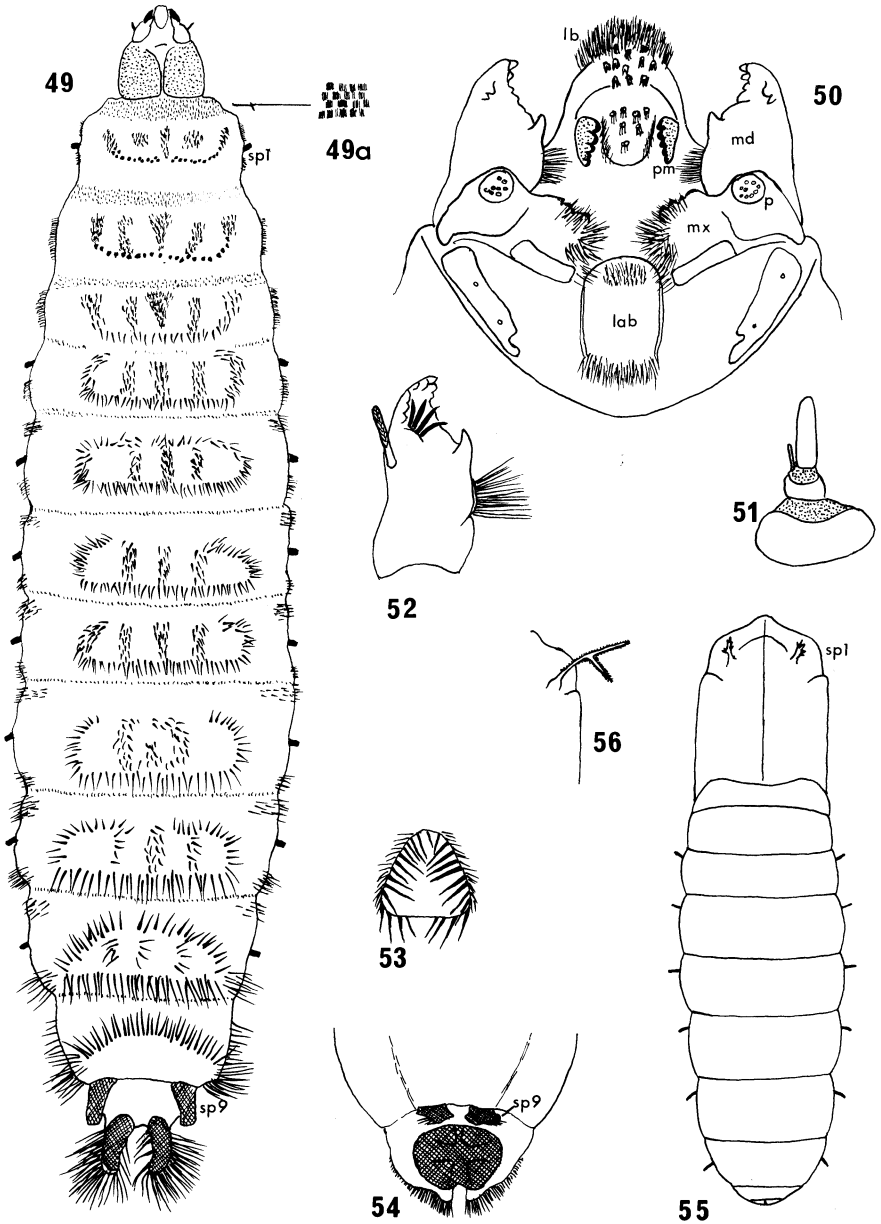
Figs. 27-39. *Bibio*. 27, *B. marci,* antenna, hairs omitted. 28, *B. nigriventris,* same. 29, *B. clavipes,* apical two segments of maxillary palp. 30, *B. lepidus,* same. 31, *B. clavipes,* posterior femur and tibia of male. 32, *B. johannis,* posterior leg of male. 33, *B. leucopterus,* apex of posterior tibia to show spurs, clothing hairs omitted. 34, *B. marci,* same, at half the scale. 35, *B. reticulatus,* same, same scale as *leucopterus.* 36, *B. marci,* base of posterior tarsus of male, one spur only shown and no clothing hairs. 37, *B. pomonae,* same. 38, *B. varipes,* same. 39, *B. lanigerus,* same.



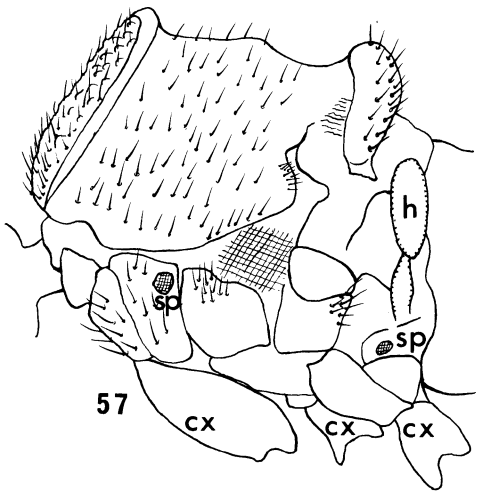
Figs. 40-41. Scatopsidae. 40, *Apiloscatopse picea,* male in lateral view, rather stylized. 41, *Scatopse notata* wing, notation of veins from Cook, 1981. *fv,* false vein. *1, 2, 3,* sections of costal margin.

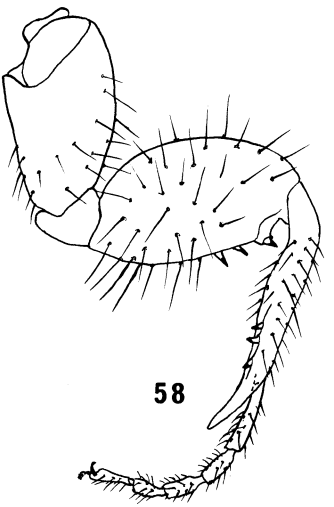


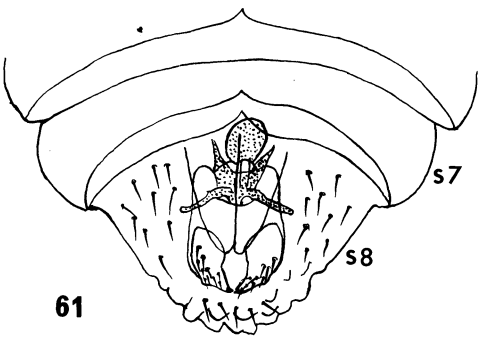
Figs 42-48. Scatopsidae. 42, *Aspistes berolinensis,* front view of head of female. 43, *Apiloscatopse picea,* same of male. 44, *Anapausis soluta,* same of female. 45, *Swammerdamella brevicornis,* head of male in lateral aspect. 46, *Coboldia fuscipes,* lateral view of thorax to show named setal groups, after Cook 1974. 47, *Apiloscatopse picea,* lateral view of upper part of 4th abdominal segment to show pleuron. 48, same, vesica or sperm pump with sperm duct and penis base. *ae.* anepisternal. *ap,* apodeme. *as,* anterior spiracular. *cx,* coxa. *ep,* episternal. *fl,* flagellum. *h,* halteres. *lab,* labellum. *le,* lower epimeral. *mp,* maxillary palp. *oc,* ocellus. *p,* pedicel. *pe,* pre-episternal. *pl,* pleuron. *pn bs,* penis base. *res,* reservoir. *s,* scape. *sa,* supra-alar. *sba,* sub-alar. *sc,* scutellar. *sd,* sperm duct. *ss,* subspiracular. *terg,* tergum.



Figs. 49-56. Scatopsidae, larvae and pupae. 49, *Scatopse notata,* dorsal view of larva; 49a, enlarged view of setae in neck region. 50, same, mouthparts in ventral view. 51, same, antenna, membrane stippled. 52, same, dorsal view of mandible. 53, same, anus. 54, *Ectaetia platyscelis,* apex of larval abdomen from above. 55, *Scatopse notata,* pupa, after Morris 1918. 56, *Rhexosa* sp., prothoracic spiracle of pupa, after Cook, 1981. *lab,* labium. *lb,* labrum. *md,* mandible. *mx,* maxilla. *p,* maxillary palp. *pm,* premandible. *sp. 1,* prothoracic spiracle. *sp 9,* last abdominal spiracle.





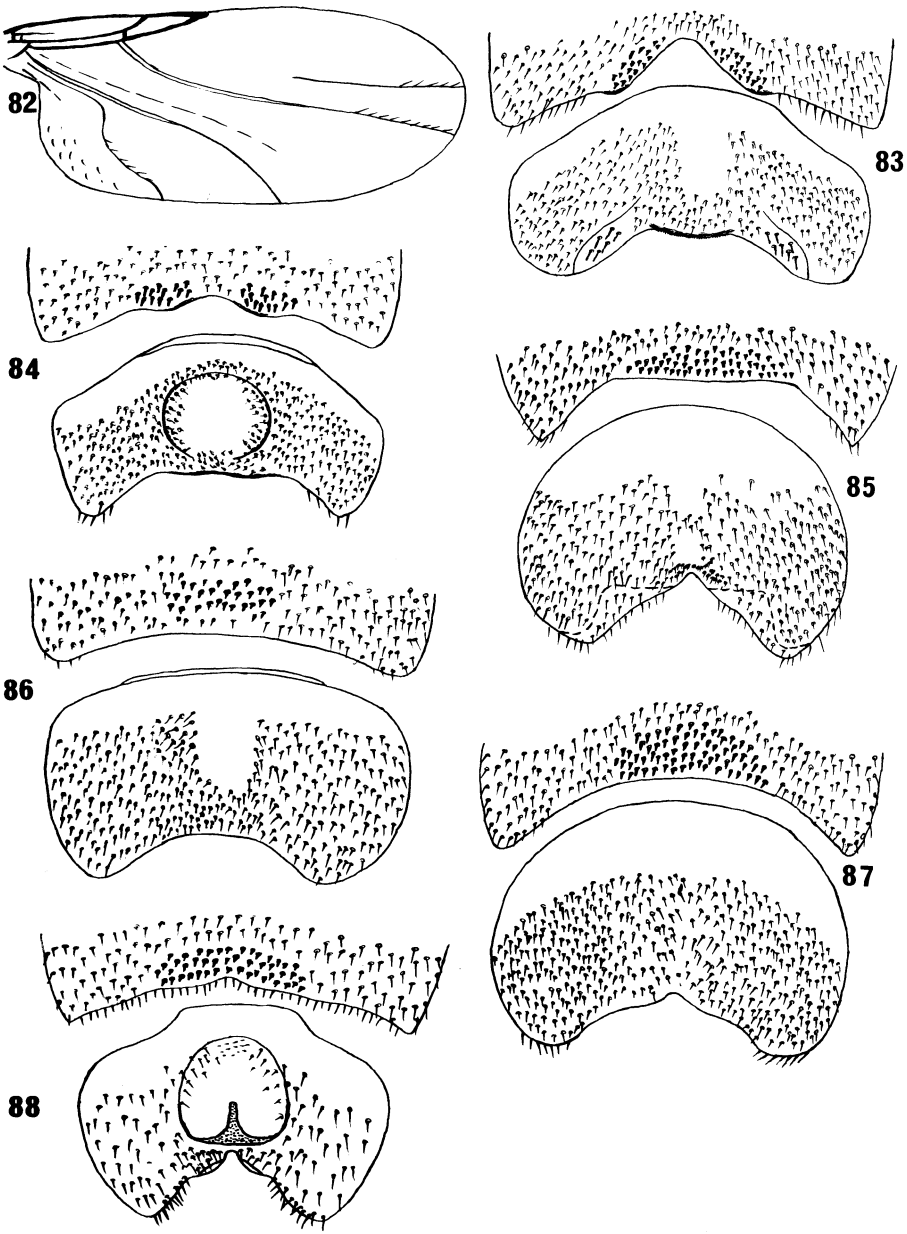


Figs. 57-61. *Aspistes berolinensis.* 57, thorax of male in lateral aspect, slightly tilted. 58, front leg of male from outer side. 59, wing. 60, posterior tibia of female from inner aspect. 61, ventral view of apex of male abdomen, main clothing hairs omitted. *cx,* coxa. *h,* halteres. *s7, s8,* seventh and eighth sternites. *sp,* spiracle.

Table 2: Summary of damage caused by bibionid larvae

Species & crop	Locality	Notes	Reference
Dilophus febrilis			
Spring barley	E. Matfen, Northumberland	Hollowed out seed, coleoptile and eaten below ground level, April. Pig manure spread previous July. 2.5ha of 5ha field completely destroyed. Max. numbers 3,500 larvae/sq m.	Port & French, 1984
Spring barley	Heddon, Northumberland	Grain and shoots eaten. Grass previous year. 0.3ha of 2ha field badly affected.	Port & French, 1984
Spring barley	N. Yorkshire Wolds	Several ha affected. Spring.	N. French, *in litt.* 1981
Spring barley	Cassington, Oxon.	1 acre eaten bare. May.	H. Roberts, *in litt.* 1980
'cereals'	Edinburgh	May.	D.A. Cooper, *in litt.* 1983
Pasture	Auchincruive, Ayr	Patchy damage to grass. April.	G. Stewart, *in litt.* 1983
Grass (amenity)	Wales	Up to 37,000 larvae/sq.m	Edwards, 1941
	Winchester, Hants.	Playing fields damaged. April.	C.Beck, *in litt.* 1977
	Croydon, Surrey	Lawn grass. March 1938.	Duffield, 1930; Cameron, 1936
	Manchester	Bowling green. August 1948.	RHS, Wisley records
	?	Turf	RHS, Wesley records
Maize	nr Reading, Berks.	Roots attacked. Farmyard manure used. August.	Lovibond, 1938
Sugar beet	nr Colchester, Essex	Plants in state of collapse, superficial resemblance to wireworm attack. Pig manure applied prior to planting. May.	C. Beck, *in litt.* 1978 G. Winder, *in litt.* 1976
Potatoes	Thornborough, Bucks.	Tubers damaged. Heavy dressing manure applied. August.	C. Beck, *in litt.* 1978
	Bridgewater, Somerset	Damaging tubers. 2 ha damaged. Heavily manured previous winter ploughed late spring, planted April, damage December.	M. Savage, *in litt.* 1983
Lettuce	Windsor, Berks.	Damaging plants in frames.	C. Beck, *in litt.* 1978
	Blackwater, Hants	March, 1927	RHS, Wisley records
	Twickenham, Middx	Larval masses at roots. March 1934.	RHS, Wisley records
Hops	Surrey	Damaging roots, 1921.	Edwards, 1925
	—	Damaging roots and crowns.	Theobald 1908; 1909a
Tomato	Bishops' Stortford, Herts	Destroying seedlings	Edwards, 1925
Chrysanthemum	Bradford, Yorks.	Attacking roots, in greenhouse	Edwards, 1925

Bibio hortulanus			
Hops			Theobald, 1913
Anemone japonica	Wisley, Surrey	Attacking roots, February.	Edwards, 1925
Bibio johannis			
Larch	—	Damaging roots of saplings	Edwards, 1925
Winter wheat	Cambridgeshire	Damage during late February — early March, emerged April.	P. Cranston, pers. comm. 1984
Bibio leucopterus			
Grass	—	Larvae around roots	Bryce, 1953
Bibio marci			
Celery	Wisley, Surrey	Attacking roots	Edwards, 1925
Asparagus	Wisley, Surrey	Root damage	Edwards, 1925
Rose	Capel, Hants	Root damage, November 1933	RHS, Wisley records
Saxifraga	Wisley, Surrey	Damage to roots March 1922, adults emerged May.	RHS, Wisley records
Grass (lawn)	Albury, Surrey	Damaging turf at rate of 75-100 cm in 24 hours.	RHS, Wisley records
Lettuce	Walton on Thames, Surrey	March 1945	RHS, Wisley records
Polyanthus	—	Root damage	Anderson, 1919
Bibio nigriventris			
Larch	Dublin, S. Ireland	Attacking roots, May	Edwards, 1925
Larch	Aberdeen	Attacking roots, May	Edwards, 1925
Bibionidae indet.			
Rhubarb	—	—	Theobald, 1909
Celery	Whittlesford, Cambs.	Making shallow burrows in blanched sections of stems, November	M. Savage, *in litt.* 1977
Sugar beet	Suffolk, several sites	"dozens of larvae in a handful of soil often only where inorganic fertilisers used"	W. Thornhill, *in litt.*



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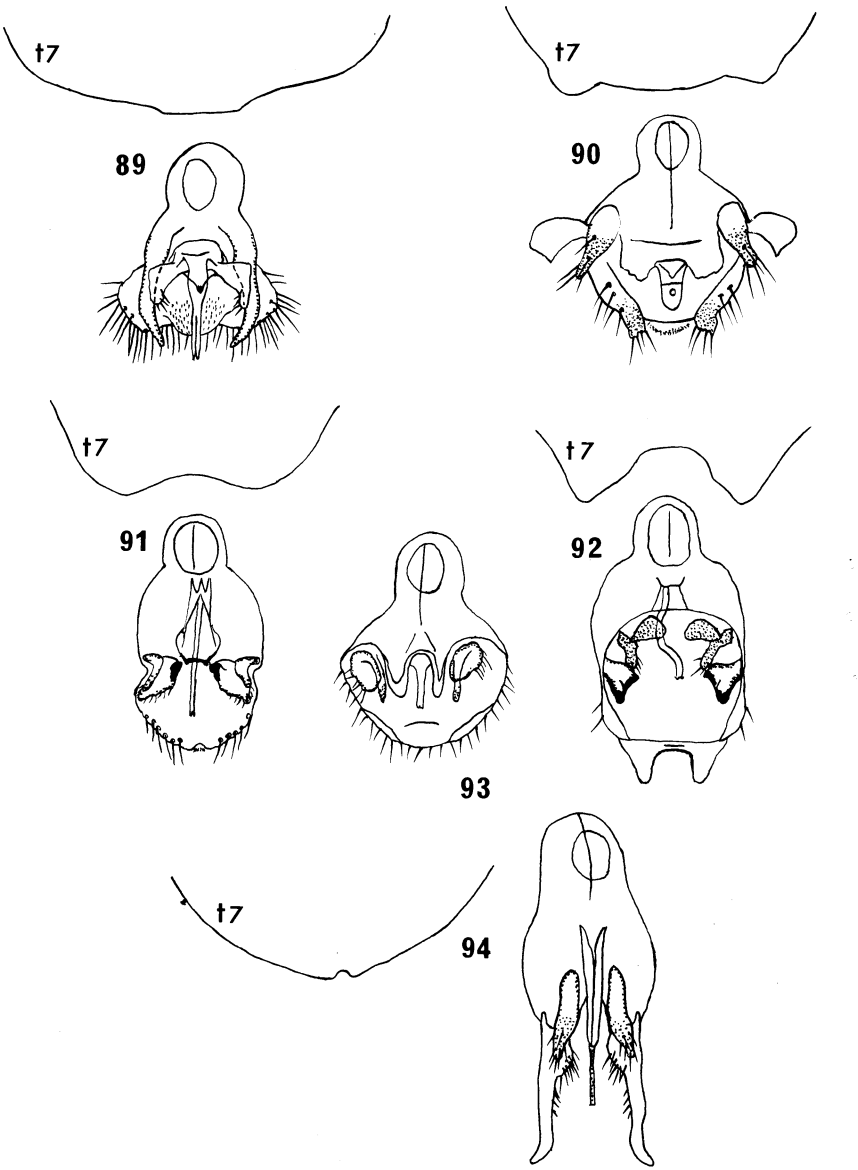

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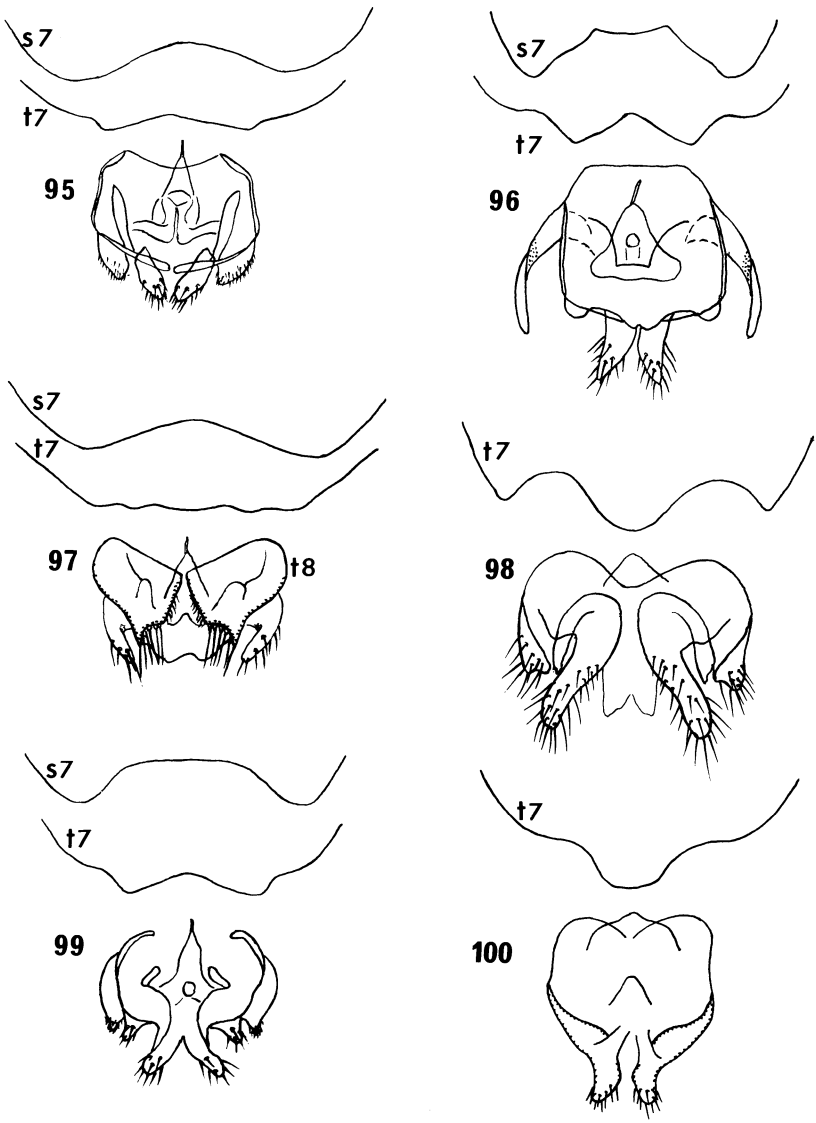

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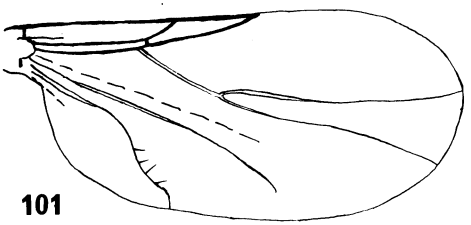

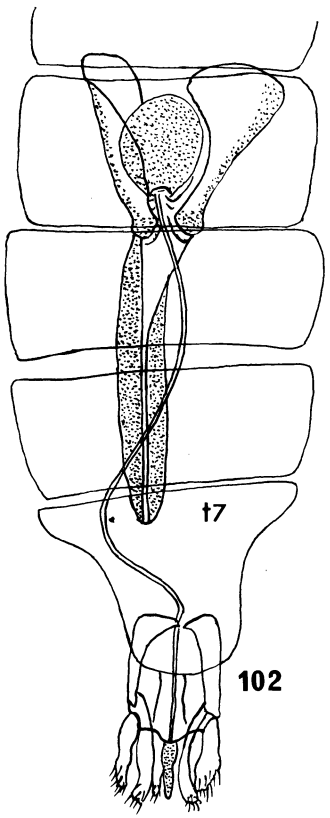

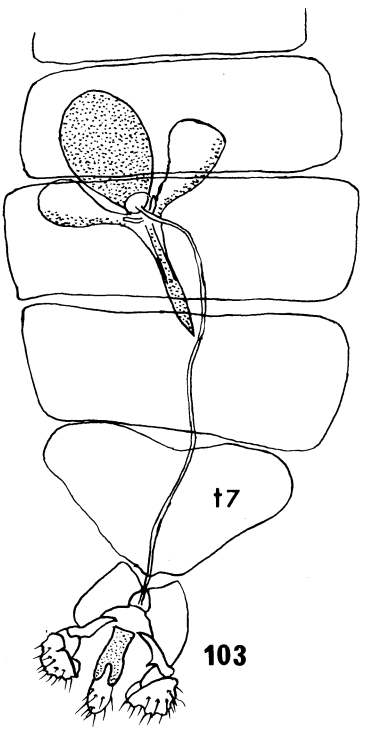

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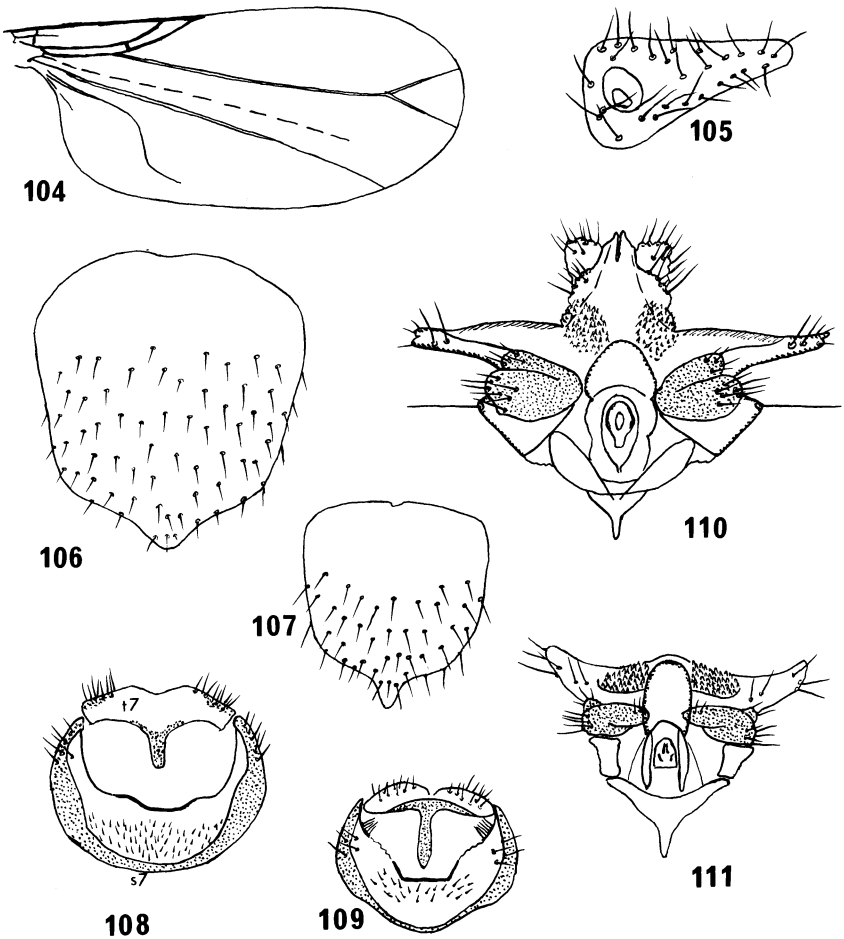

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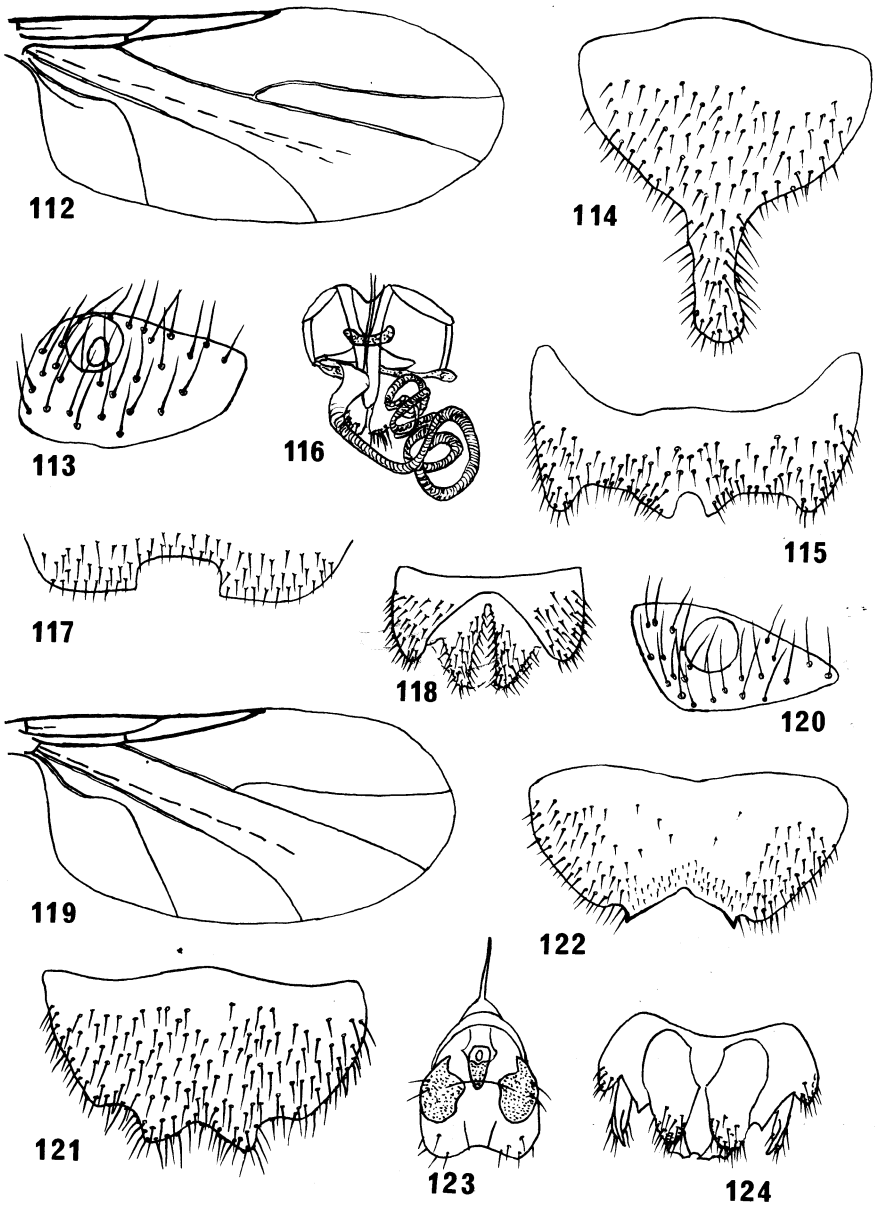

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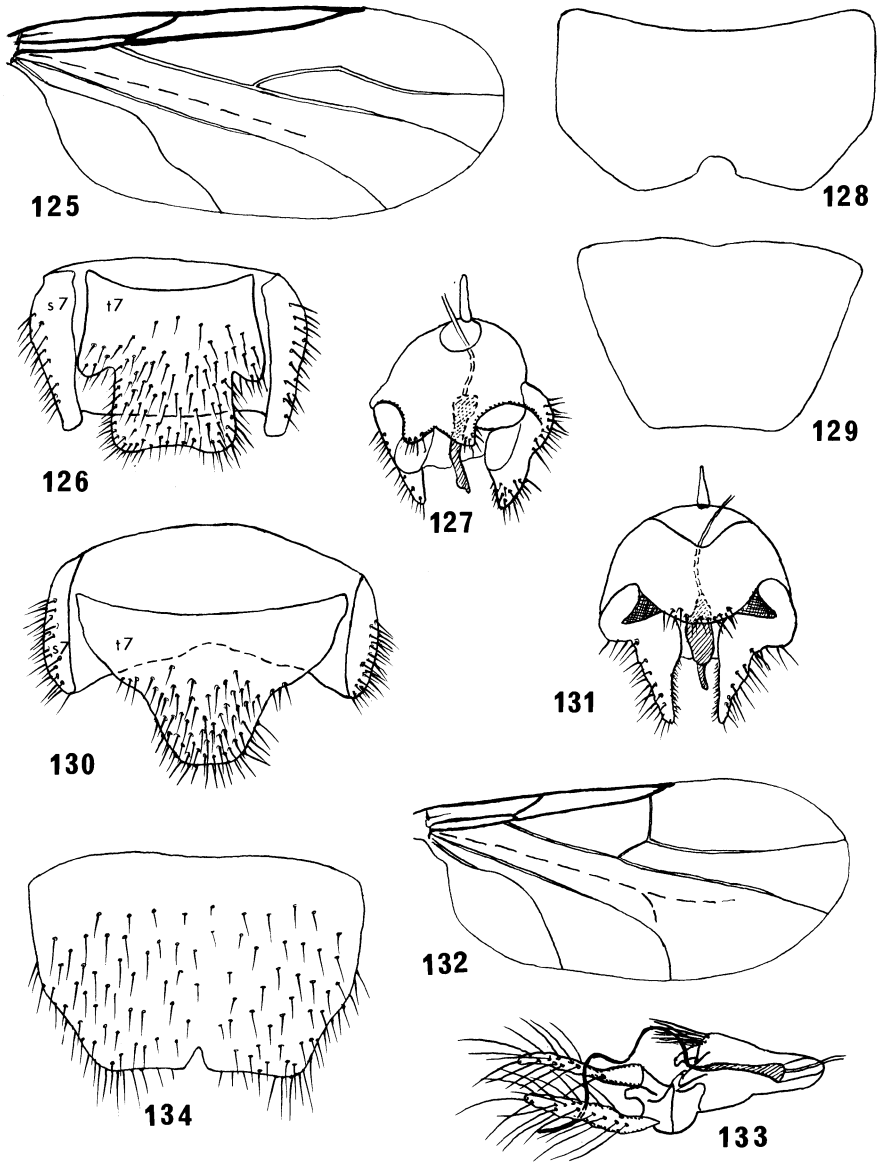

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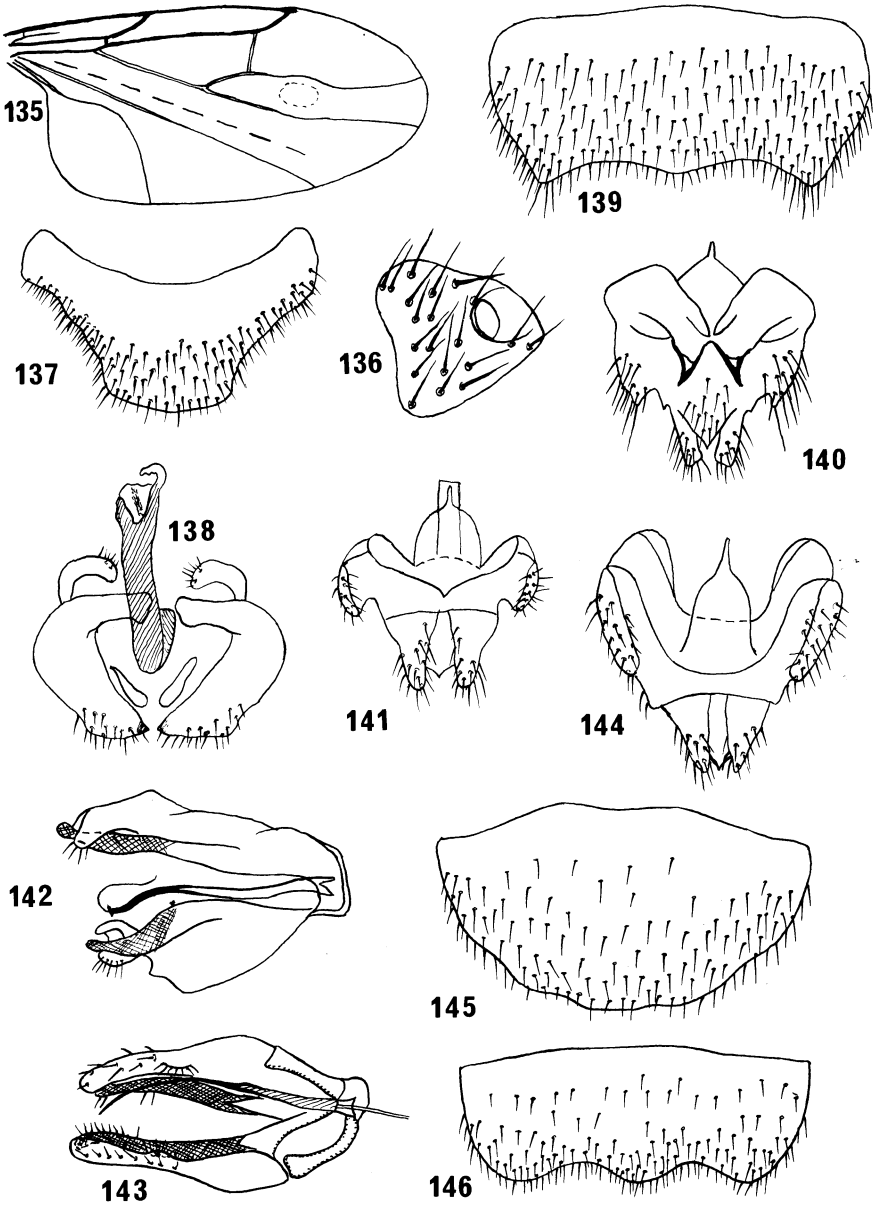

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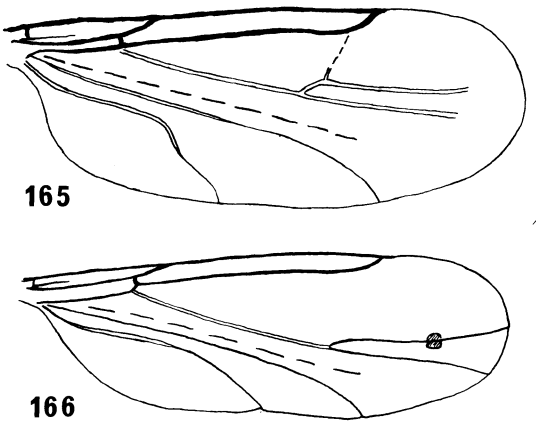

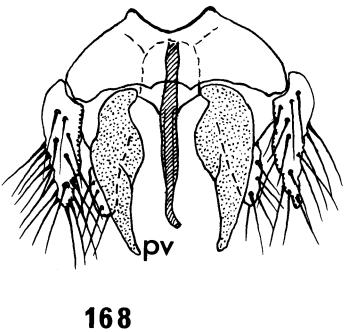

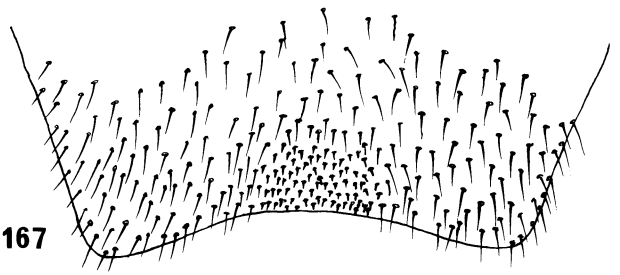

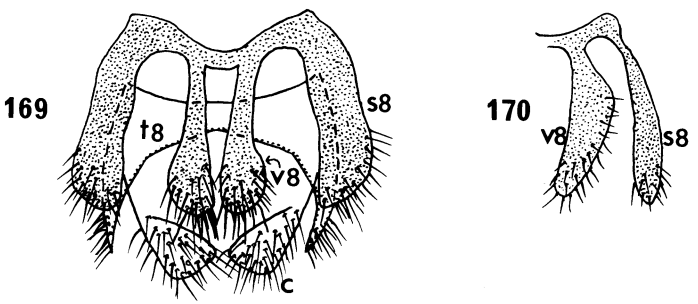

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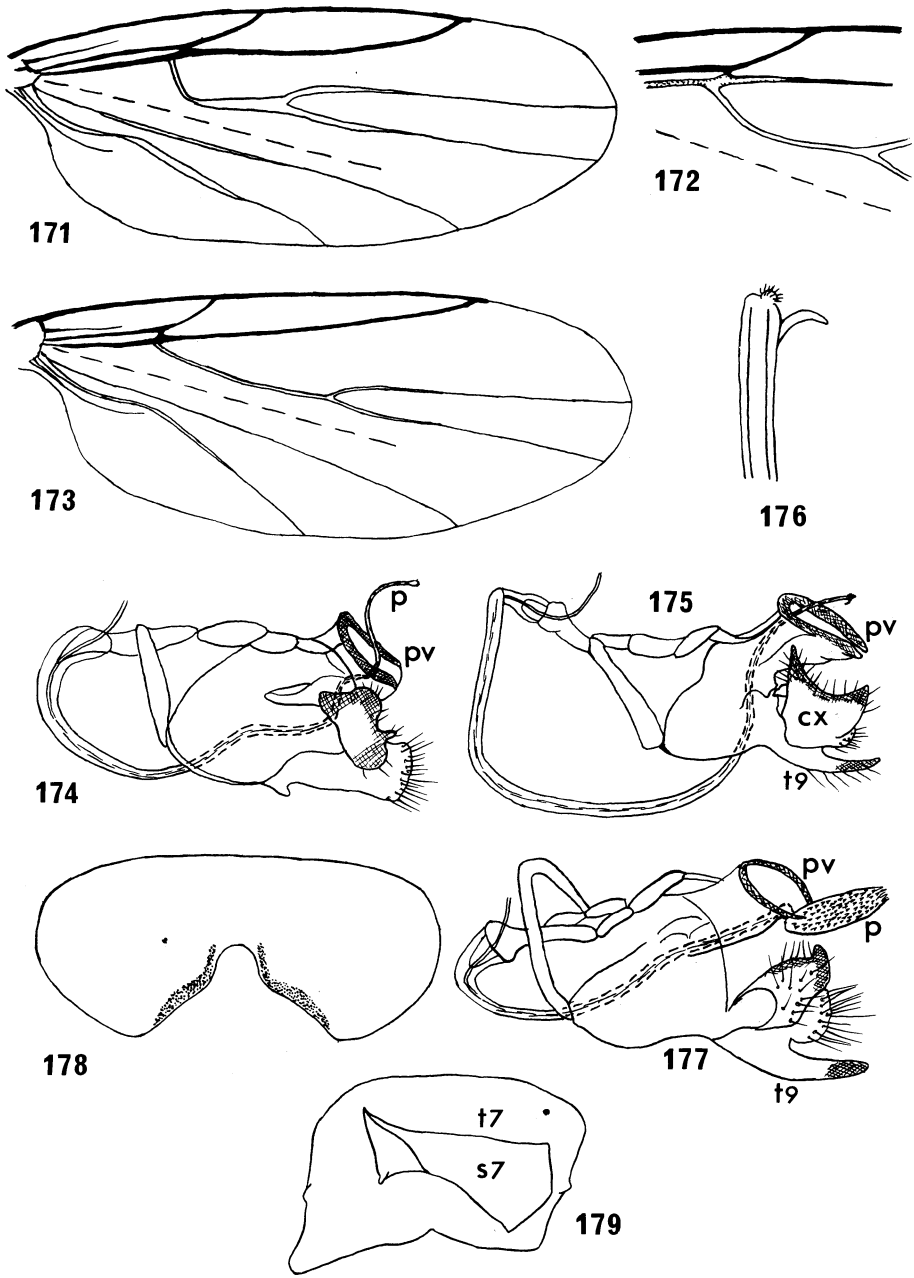

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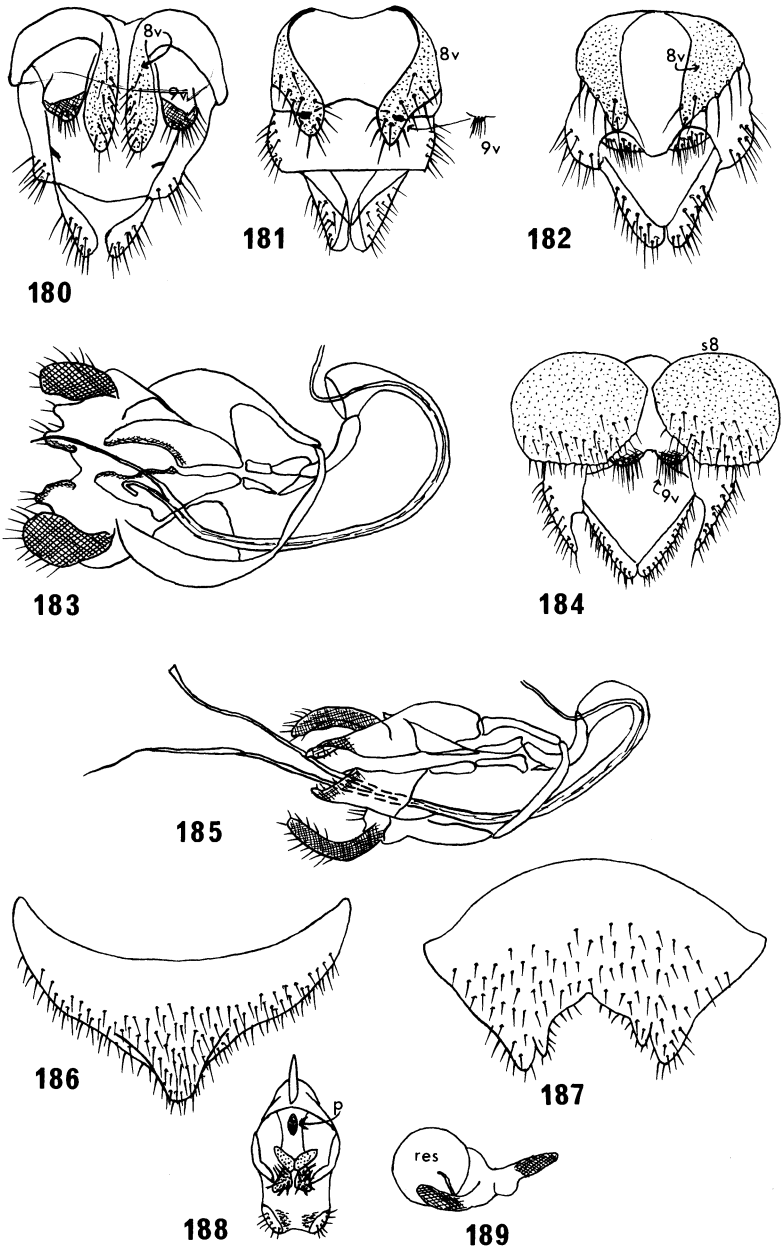

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