BEES, ANTS AND WASPS

A key to genera of the British Aculeates

by Pat Willmer

FIELD STUDIES COUNCIL

AIDGAP TESTED

Occasional Publication
No 7.

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THE BRITISH ACULEATES

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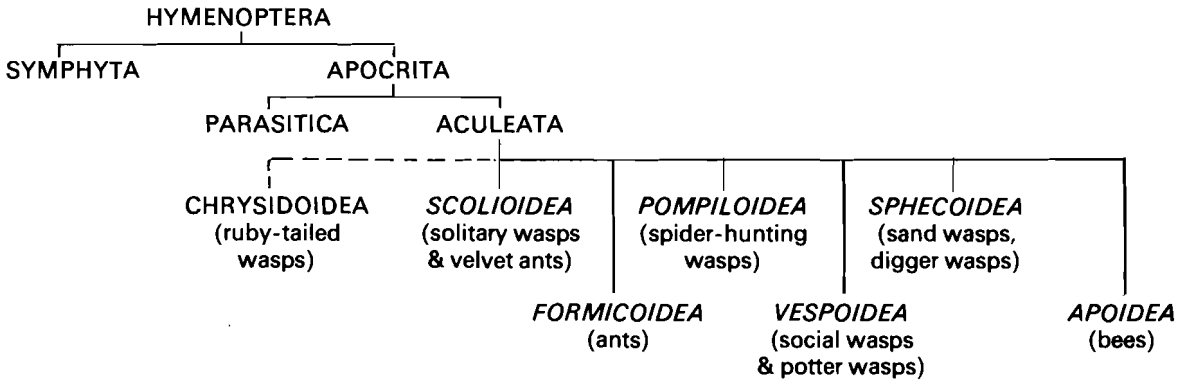
By Pat Willmer

Department of Zoology, South Parks Road, Oxford OX1 3PS

INTRODUCTION

The Aculeates are one of the major sub-divisions of the large insect order Hymenoptera, and are generally known as ants, bees, and (more loosely) wasps. The order is usually split into the Symphyta, or sawflies, which lack the constricted 'waist' between thorax and abdomen; and the Apocrita, which display this feature. The Apocrita are further sub-divided into 'Parasitica' and 'Aculeata', but these are rather artificial groupings and have some overlapping features. The Aculeates are represented by seven superfamilies, but one of these is clearly intermediate with the Parasitica; this is the group Chrysidoidea, which is sufficiently different from the typical Aculeate plan to be excluded from this key. The six remaining superfamilies are shown in this simple scheme of the order:



The six groups included in this set of keys (italicised above) thus encompass many of the most familiar insects, attractive both to amateur naturalists and to professional scientists for their range of behaviour and ecological habits. Whilst the social members of the group are quite well studied, many of the smaller and solitary forms are still little known, and an enthusiastic amateur can contribute very valuable observations. This booklet is designed as an aid to identification, to the generic level, for all of these insects, since most of the available keys at present are accessible only to experts and can be very difficult to use until one is familiar with the groups and their microscopic features.

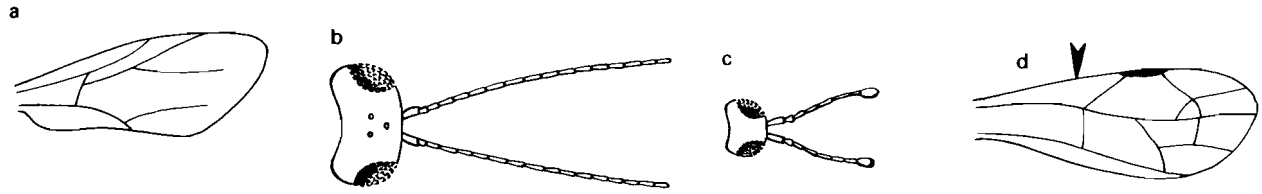
RECOGNISING ACULEATES

The six groups of aculeates treated here share the following set of characters:

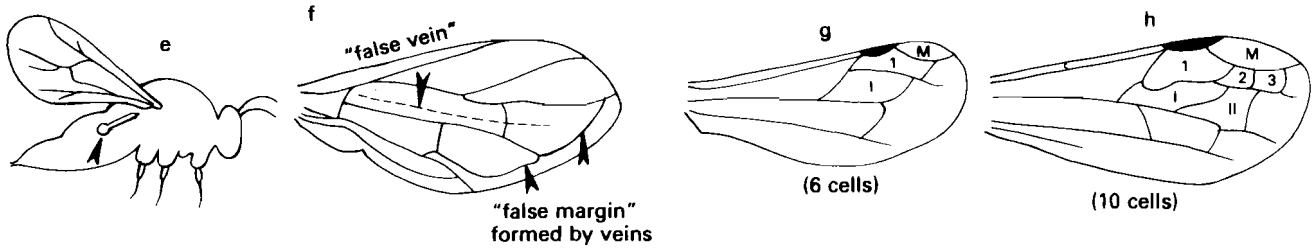
1. *A narrow waist,* sometimes elongated as a 'petiole'. The waist actually comes between the first and second true abdominal segments, so that the first segment of the abdomen becomes effectively joined to the thorax and is given the special name of 'propodeum' (see Illustrations and Glossary on pages 6–8).
2. *A sting* in females, formed from the modified ovipositor. Unlike the ovipositor of the Parasitica, which usually protrudes visibly, the aculeate sting is retractable and hidden when not in use.
3. *12 (♀) or 13 (♂) antennal segments,* almost invariably. Occasionally, there are only 10 or 11 segments; but there are never more than 13 or less than 10.
4. *6(♀) or 7(♂) abdominal segments* visible from above.
5. *Two pairs of wings* generally, though absent in many ants and some scolioids. The forewings have 6–10 rounded cells (areas enclosed by veins), and the two pairs of wings are linked by small hooks borne on the front edge of the hind wing.

Using these features, and with a little practice, aculeates can be readily recognised. But beginners may have some trouble distinguishing them from certain other groups, and the following notes and illustrations may help:

a) Some larger Parasitica may look like true 'wasps'; they can be excluded by the reduced venation of the wings (having fewer than 6 cells, as in Fig. a), or in the case of the common ichneumons by having long antennae with at least 16 segments (as in Fig. b). There are also a few small members of the Parasitica which have too few segments to the antenna (Fig. c), or where the wings have only a tiny stigma and a very narrow or even completely obliterated costal cell (Fig. d).



b) Some flies from the order Diptera, are mimics of bees and wasps; especially the striped yellow and black flies in the families Syrphidae (hover-flies) and Conopidae. But flies always have only one pair of wings, with the hind wings reduced to small club-like halteres (Fig. e), and in the hover-flies there is a characteristic venation (Fig. f) very different from the aculeates. Winged aculeates always have two wings, though these are hooked together; and they always have a venation pattern somewhere between the extremes shown in Figs. g and h.



ECOLOGY OF ACULEATES

Most aculeates are free-living, flying insects, some examples of which can be found in most habitats from early spring through to autumn; but they are particularly common on sunny days and in drier or sandy areas. Some are wingless (most ants, and some female scolioids), and even some of those which have wings seem to prefer walking to flying (especially the spider-hunting pompilids).

The majority of the 'wasps' are entomophagous, collecting a variety of arthropod prey on which to feed their young within specially constructed nests, whereas bees feed their young on nectar and pollen instead, and ants use a variety of both vegetable and animal foods. However, most adult aculeates need high energy food for their own immediate use as well, and so will feed on flowers to obtain sugary nectar. A few aculeates are specialised as parasites of other species, either living within the host nest or stealing provisions for their own use.

The most familiar of all the aculeates are the social forms, living in large colonies with only a few reproductively active individuals; the honey bee and bumble bees, the ants, and the 'yellow-jacket' wasps. These social insects have a caste system, which can cause problems of identification. By far the commonest forms are the workers, sterile females which collect food for the nest or hive but do not mate or lay eggs. In ants they are generally wingless. Males and queens are less frequent, but may show seasonal variation in abundance. For example, swarms of winged male ants can occur when the queen ants are ready to mate, and many queen bumble bees may be found early in the spring when they seek new nest sites and forage for food to establish the new colony of workers to supply their subsequent needs. Where sex and caste are important factors in identification, notes are given in the keys to help you.

Brief notes on the ecology and habits of each group are provided with the introductory sections of the keys. Further information on periods of activity, habitat, nesting sites and prey may be found in the references listed at the end of each key, and general background reading is provided by a number of early sources such as Lubbock (1888), Saunders (1896), Schmiedeknecht (1930) and Step (1932), if these can be obtained. More recent summaries of ecological notes are given in the Hymenopterist's Handbook (reprinted 1969), and in books by Krombein (1967), Malyshev (1968), Iwata (1976) and Bohart & Menke (1976). Useful material on the social representatives of the ants, bees and wasps is given in Wilson (1971), but there is, regrettably, no good modern work on the natural history of the aculeates as a whole.

COLLECTION, PRESERVATION AND EXAMINATION

Since many aculeates have clear nesting sites to which they return, they can often be captured by patiently waiting at such a site and everting a small vial over occupied nest entrances. Vials may also be used to capture insects resting on flowers, capping the container carefully as soon as the insect flies up to the closed end. Alternatively, a net can be used as for other insects, and the captive then transferred to a vial for examination.

It may be possible to check features with a hand lens for larger species, without immobilising the animal. But you will normally need to anaesthetise or kill your specimen to be sure of correct identification, until you have built up a small reference collection and can identify in the field, from a knowledge of nest-sites and habits. Never collect and kill large numbers of specimens.

To kill a specimen, use a few drops of standard entomological anaesthetic, such as ethyl acetate or chloroform; these can most easily be added to the vial on a piece of tissue or filter paper, or you may like to use vials with a little dental plaster in the base. Allow time for the insect to succumb, as large bees and wasps are surprisingly resistant, and it is precisely these larger social species which are most likely to sting thus producing shock symptoms in a very few susceptible people. Small and solitary aculeates are most unlikely to sting, but should still be treated with respect.

Dead specimens are easiest to examine if they are mounted on a pin which may be inserted in cork or a piece of expanded polystyrene. A long pin through the insect thorax is usually convenient and smaller pins can be used to prop the wings and legs out as the insect dries and hardens. You do not need to be too fussy about this, but your insect will be easier to identify if you let it 'set' thus, with all appendages roughly outspread. Then you are ready to examine it; a hand lens may suffice, though a microscope will certainly make life easier for you in checking detailed features. For the enthusiast, specific identifications will definitely require a binocular instrument with about $\times 20$ magnification.

IDENTIFICATION—HOW TO USE THE KEYS

Aculeates cannot be identified properly just by comparing them with pictures, so keys must be used. The keys given here are specially designed to be easy to use for non-specialists, avoiding characters which are hard to define or difficult to see without very good equipment. They are presented as algorithms, for ease of understanding and speed of use.

Once you are sure you have an aculeate, start with the key to superfamilies, KEY A, on page 8. The principle is simple

Read both parts of a couplet; check your specimen carefully, looking at the features on both sides of the body; select which characters fit your specimen; follow the line

Check any unfamiliar terms with the glossary and illustrations on pages 6–7; and check specific features with the illustrations that accompany the key. Once you have decided on a superfamily, find the right key and repeat the procedure, to arrive at the correct genus. Where there is any doubt about a character here, an insect will key out both ways, so do not worry too much. For each genus, there is a set of confirmatory characters, and these will probably show you if you have made an error—if so try again more carefully. The confirmatory characters include sizes (from the head to the tip of the abdomen), and colour, and rarity (common unless otherwise stated). The number of species in the genus is also given in brackets at the end of the algorithm, adjacent to the generic name.

When you have identified the genus, and checked these confirming characters, you may like to read more about the group and to follow your specimen through to specific identification. To assist you in this, a number of references are given at the end of each section. Final identification may need consultation with an expert or with a good museum collection, especially if you think you have a rarity; you should at least check in the available keys to species that the animal identified does occur in your area, and be very suspicious of your labelling if it seems geographically unlikely. Note that genera which are described as rare or locally common are nearly always restricted to the southern half of the British Isles, often to counties bordering the Channel. You will encounter far fewer species north of the Humber–Mersey line, and a few extra ones if collecting in the Channel Islands.

(For further information on taxonomy and identification–see footnotes and references, below)

FOOTNOTES

1. If you have become interested in the aculeates, you might consider joining the British 'Bees, Wasps & Ants Recording Scheme' (BWARS). This group seeks to map and record out native species, and would be grateful for your cooperation; they may also help with identification. Requests for information can be made to George Else, at 6, Greenhill Close, West Hill Park Estate, Winchester, Hants SO22 5DS.
2. The keys presented in this booklet are largely based on earlier works dealing with various subsections of the aculeates—all are referred to below. The terminology follows that of the current Checklist of British Insects, produced by the Royal Entomological Society

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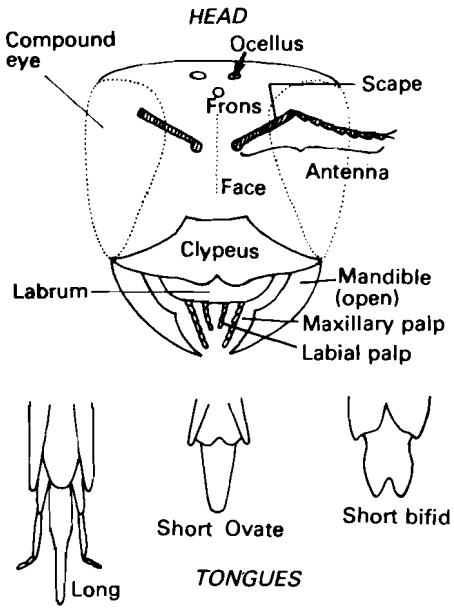
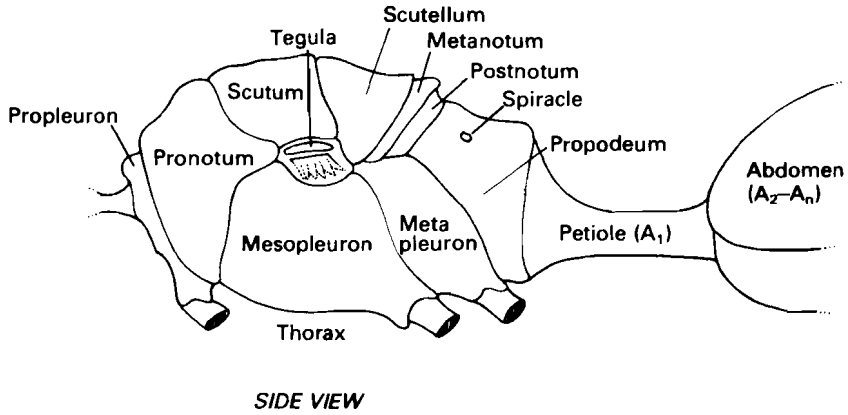
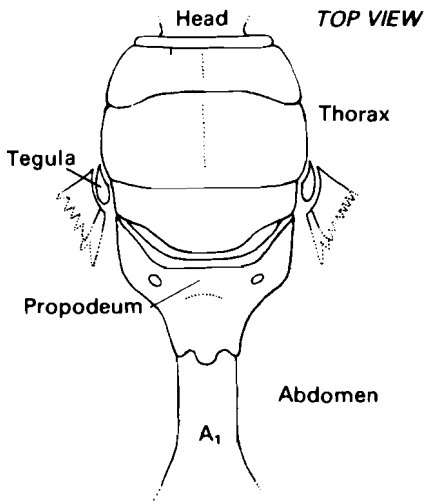
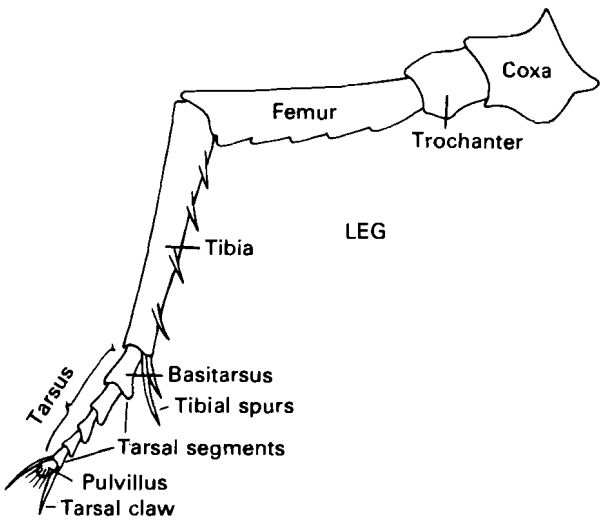
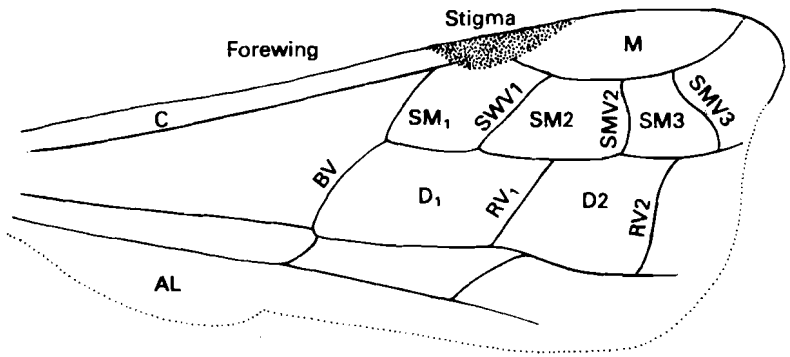
ACULEATE STRUCTURE AND TERMINOLOGY

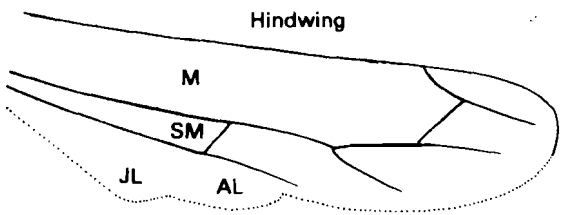












GLOSSARY

Acidopore The conical pore at the tip of the abdomen of some ants from which defensive secretions may be released.
Arolia The small cuticular pad between the claws on each foot.
Bifid Having two lobes or branches, especially referring to the shape of the end of the tongue.
Bifurcate Having two forks or prongs, particularly referring to claws or to spines on the legs.
Carina A ridge or keel of raised cuticle.
Emarginate With the margin indented, particularly referring to eye-shape and giving rise to a kidney-shaped eye (see Figs. 38 & 39).
Ocellus A simple eye (pl. *ocelli*). Usually found in a triangular group of three, on the frons, between the much larger compound eyes.
Ovate Roughly oval; usually referring to the eyes.
Pectinate. Bearing long stout hairs in a regular row, like a comb.
Petiole A waist formed by narrowing, and often lengthening, of one or two abdominal segments. Technically, the segments involved are A2 (and sometimes A3), the A1 being fused to the thorax and forming the propodeum—see below. However, to avoid confusion, petiolate segments are labelled as A1 ($\pm$A2) in this key. The petiole bears scales or nodes in ants.
Propodeum The first abdominal segment, which appears to form the back of the thorax. Lies immediately in front of the narrow waist. Only segments behind the propodeum are labelled in this key, as A_1–A_n: see above.
Pubescence Short and usually dense hair, appearing almost as a fur.
Punctate Cuticle which is pock-marked by small indentations, usually making the surface appear dull.
Rugose Cuticle which is sculptured into irregular ridges or bumps, with a very roughened appearance.
Scape Basal segment of the antenna–often elongated.
Spiracle A small hole, particularly noticeable on the propodeum, which allows gas exchange and respiration. Can be sealed by a flap of membraneous cuticle, often guarded by hairs.
Stigma The pigmented, roughly semi-circular area on the leading edge of the fore-wing.
Striate Cuticle raised into a series of fairly regular parallel ridges.
Tegula The small pad lying just above the wing base, almost like a shoulder pad.
Tergite The plate of cuticle which forms the top, dorsal part of each segment, particularly referring to the abdominal segments.
Tibial spurs The spine-like processes at the distal end of the tibiae; there are generally 1 or 2 on each leg, and the formulas given as 1, 1, 2 (etc.) in the confirmatory characters refer to the number of spurs on fore, mid and hind legs respectively.

SYMBOLS

♂ Males
♀ Females; Queens in social species
☿ Workers; the sterile females of social species
$> \geqslant$ Greater than: greater than or equal to
$< \leqslant$ Less than; less than or equal to
$\simeq$ Approximately the same as
→ eg. $RV_1 \rightarrow SM_2$. The arrow indicates that vein RV_1 meets the margin of cell SM_2, rather than SM_1 or SM_3. Always look carefully and check both wings.

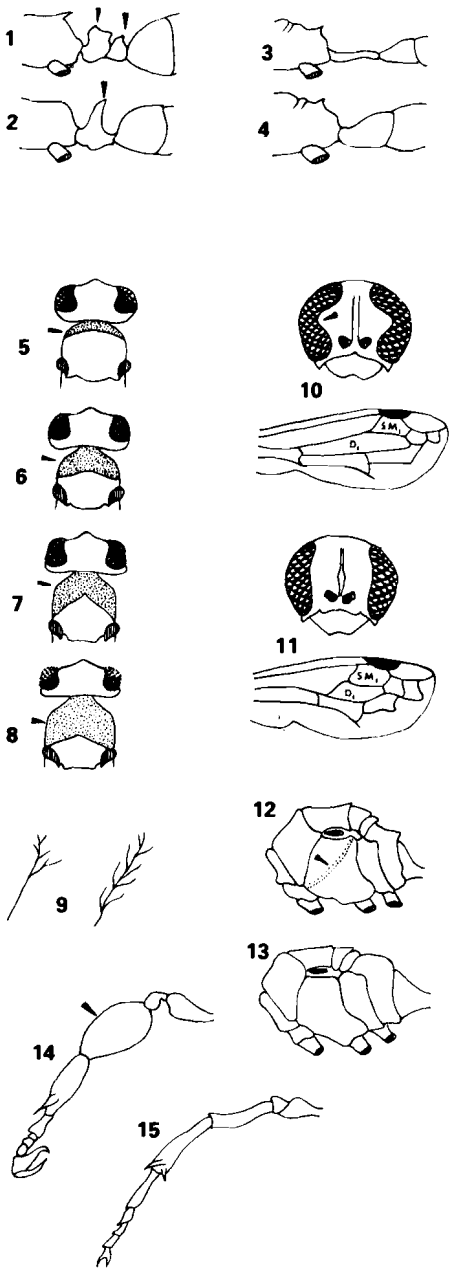
ABBREVIATIONS

C	Costal cell
M	Marginal cell
SM	Submarginal cell
D	Discoidal cell
SD	Sub-discoidal cell
AL	Anal lobe
JL	Jugal lobe
BV	Basal vein
RV	Recurrent vein
SMV	Submarginal vein
MN	Metanotum
PN	Postnotum
MP	Maxillary palps
LP	Labial palps
Cly	Clypeus
A_{1-n}	Abdominal segments
Th_{1-n}	Thoracic segments
T_{1-3}	Tibiae 1–3

KEY A — *KEY TO THE SUPERFAMILIES*

- Wings present
  - Hind wing lacks cells → *CHRYSIDOIDEA**
  - Hind wing with cells
    - Petiole with scales or nodes [1] [2] → *FORMICOIDEA* (2 sections: p. 12-15)
    - Petiole absent or simple [3] [4]
      - Pronotum from above short, straight or slightly curved at the back; or unseen due to dense hair [5] [6]
        - Usually very hairy; at least some hairs branched or feathery [9] especially near tegulae. Hind tibia and tarsus often enlarged. → *APOIDEA Key G* (2 sections. p:24-27)
        - Sparsely hairy, and hairs all unbranched → *SPHECOIDEA Key F* (3 sections: p.18-23)
      - Pronotum long, and deeply indented at the back; reaching back to the tegulae. [7] [8]
        - Wings fold up longitudinally. Cell D1 long ≙ 2 x SM1. Eyes always emarginate [10] → *VESPOIDEA Key C* (1 section: p.11)
        - Wings not folded. Cell D1 usually shorter. Eyes usually ovate [11]
          - Mesopleuron with an oblique suture [12] → *POMPILOIDEA Key E* (1 section: p. 16&17)
          - Mesopleuron without this suture [13] → *SCOLIOIDEA Key B* (1 section: p.10)
- Wings absent
  - Petiole with scales or nodes [1] [2] → *FORMICOIDEA Key D* (2 sections: p.12-15)
  - Petiole simple or absent [3] [4]
    - Front femur dilated [14]. Only 3-4 abdominal segments visible, often highly metallic → *CHRYSIDOIDEA**
    - Front femur not dilated [15]. 6 or 7 abdominal segments visible → *SCOLIOIDEA Key B* (1 section: p.10)

* *Chrysidoidea* are keyed here, but are not included in the generic keys - see Introduction to the guide



CONFIRMATORY NOTES ON THE SUPERFAMILIES

Scolioidea A small group of rather variable 'wasps', mostly uncommon, and frequently with ant-like wingless females. Eggs are laid on other Aculeates or on beetles. Winged males often found on flowers, especially Umbellifers. Pronotum long and usually indented at the back. Tongue blunt and bifid, short except in *Sapyga*. Most are black ± red markings. 6 genera, 8 species.

Formicoidea The ants. Mostly small, all with scales or nodes on the petiole. Found in all habitats, feeding the larvae on animal matter, seeds, fungi, etc., according to species; some are social parasites of other ants. Structurally variable, with a caste system of queens, males and workers (these are sometimes of two types). May be sexed by the number of visible abdominal segments (♀ and ☿6, ♂7, as viewed from above); males are usually winged, and workers always wingless, queens have wings initially and retain the wing-base attachment on the thorax which workers lack. 15 genera, 41 species, indigenous to Britain; there are also some established introductions in the genera *Pheidole, Paratrechina, Plagiolepis, Crematogaster, Iridomyrmex, Camponotus* and *Monomorium,* and additional introductions from the indigenous keyed genera *Tapinoma* and *Tetramorium* (mostly to be found around heated buildings).

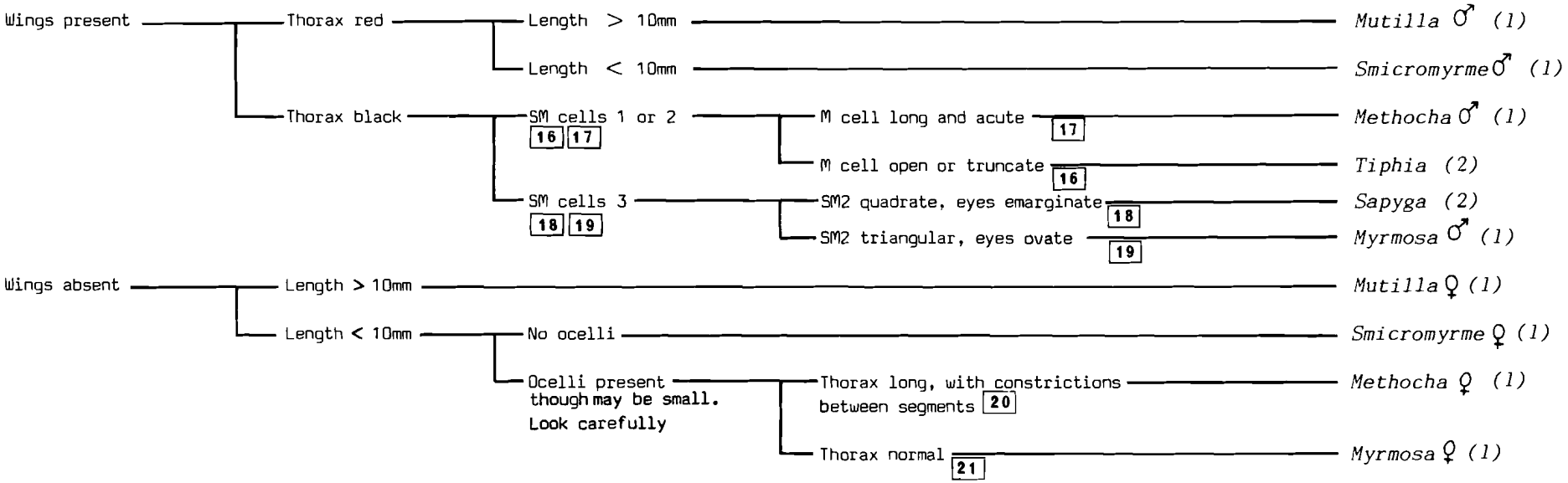
Pompiloidea The 'spider-hunting wasps', generally capturing spiders as larval food and dragging them back to individual nests rather than flying with them. Also to be found on flowers, often Umbellifers. Many occur in sandy places, but some are found in damp habitats and around tree stumps; a few parasitise other pompilids. Structurally rather uniform, so difficult to identify. All are black ± red, with long spiny legs and fairly narrow bodies. All with 3 SM cells and 2D cells (excepting 2 species with 2 SM cells). Antennae curl after death. Pronotum long, indented; tongue short and bifid. 14 genera, 41 species.

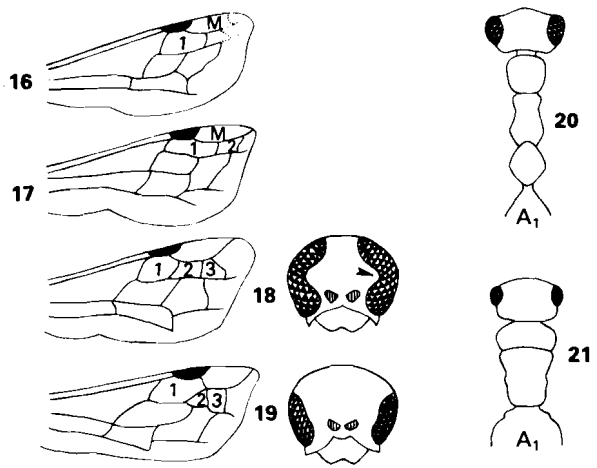
Vespoidea True wasps (which are social) and potter wasps (solitary). The true wasps (Vespidae) make large communal papery nests, above or below ground, whilst solitary Eumenidae nest in plant stems, wood, or holes in the ground, or construct mud nests. All prey on other insects; also abundant on flowers, especially in autumn. Eyes deeply emarginate, tongue short and bifid. 3 SM cells. Pronotum long, reaching to the tegulae dorsally and indented behind. Wings fold up longitudinally so appear very narrow. A2 usually longest segment of abdomen. All are black and yellow, the Eumenids blacker, Vespids yellower. Mandibles short in Vespids, long in Eumenids. 11 genera, 29 species. (*Polistes* excluded, occasional import but not indigenous).

Sphecoidea Digger wasps or sand wasps. All are solitary, but many nests may occur together and some species show the first stages of sociality. Larvae are fed on insects or spiders (or are parasites of other wasps), each species having its own favoured foods. Also frequent flowers for adult nutrition. Occur in all habitats, but most common in sandy areas nesting in the ground or in stems or posts. Variously coloured and sparsely hairy; wing venation very variable, 1–3 SM cells and 0–2 D cells. Pronotum narrow, not reaching the tegulae as seen from above though it may form lateral lobes beneath them. Tongue usually short, often bifid. 30 genera, 116 species.

Apoidea The bees. All are nectar and pollen feeders, so the tongue is usually conspicuously long, and branched pollen-gathering hairs occur. Only *Apis* and *Bombus* are truly social, other genera have solitary nests in stems, holes in ground, etc., (or are parasites of other bees). Most species have particular flower preferences. Mostly hairy and stout, but some genera sparsely hairy and more 'wasp-like'. Hind tibia and basitarsus enlarged, especially in the female. 2 or 3 SM cells, 2 D cells. Pronotum narrow, not reaching the tegulae as seen from above. MP6, LP4 unless otherwise stated. 29 genera, 249 species; (*Chalicodoma* and *Xylocopa* excluded, the former being probably extinct in Britain and the latter an occasional import from the Continent but not established).

KEY B *SCOLIOIDEA*





CONFIRMATORY CHARACTERS FOR THE GENERA OF SCOLIOIDEA

Mutilla Male bluish; silvery hairs, thorax red, legs black. Punctate. Female broad, black; golden hairs, thorax red, legs black. Both have tibial spurs 1, 2, 2. Male 11–12 mm, female 13–15 mm. Rare, especially the male. Parasites of bumblebees.

Smicromyrme Both sexes black with red thorax. Male with silvery hairs in bands, female with silvery spot on A1 and bands on others. 5–8 mm. Locally common, male rare. Parasites of sphecids.

Methocha Male long, black, very punctate with silver hairs; wings smoky, eyes hairy. Female black, red thorax, reddish legs. Tibial spurs 1, 2, 2. Male 7–11 mm, female 4–8 mm. Male rare, female locally common. Parasites of tiger-beetle larvae.

Myrmosa Male long black and shining, thorax punctate; tarsi long. Female black and red shining; thorax long, abdomen with short petiole. Tibial spurs 1, 2, 2. Male 6–12 mm, female 4–8 mm. Parasites of small sphecids.

Tiphia Black, shining, with few white hairs; wings smoky, some red on legs, A1 narrow; pronotum long, propodeum heavily ridged. Legs spiny, with tibial spurs 1, 2, 2. 5–14 mm, locally common. Parasites of root-feeding scarabaeid beetles.

Sapyga Eyes large and kidney-shaped, touching mandibles. Abdomen long, black ± yellow or red. Tongue quite long. Tibial spurs 1, 2, 2. 7–12 mm, locally common. Parasites of stem-nesting bees and wasps.

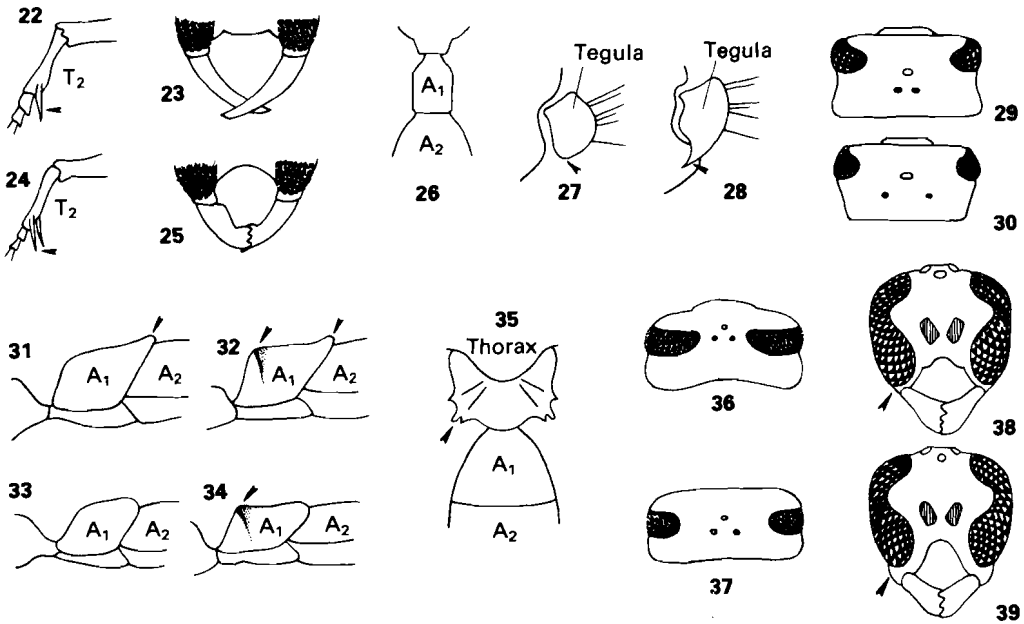
FURTHER READING AND IDENTIFICATION

Can be identified to species from Richards (1980). Notes on biology, and an outdated classification, can be found in Saunders (1896), and there are some useful ecological notes in the Hymenopterist's Handbook, but little recent work is available.

KEY C

VESPOIDEA

- Middle leg tibiae with 1 spur [22]. Mandibles long and crossed over at rest [23]. (Eumenidae)
  - Petiole present [26] — *Eumenes (1)*
  - No petiole [35]
    - Tegulae posteriorly rounded (seen from above) [27]
      - Head bulges behind eyes [29] — *Gymnomerus (1)*
      - Head roughly quadrate [30] — *Odynerus (4)*
    - Tegulae posteriorly pointed (seen from above) [28]
      - A1 with an apical swollen ridge [31] [32]
        - A1 with a transverse ridge at middle [32] — *Symmorphus (4)*
        - A1 evenly rounded [31] — *Microdynerus (1)*
      - No apical swollen ridge [33] [34]
        - A1 with transverse ridge at middle [34] — *Ancistrocerus (9)*
        - A1 evenly rounded [33]
          - Propodeum with dorsolateral-teeth, A1 dark [35] — *Euodynerus (1)*
          - Propodeum lacks teeth, orange area on A1 — *Pseudepipona (1)*
- Middle leg tibiae with 2 spurs [24]. Mandibles short and stout, meeting roughly on midline (Vespidae) [25]
  - >20 mm — Rear ocelli level with centre of eyes (from above) [36] — *Vespa (1)*
  - <20 mm — Rear ocelli level with back of eyes (from above) [37]
    - Eyes almost touch the mandibles [38] — *Vespula (4)*
    - Eyes set well above the mandibles [39] — *Dolichovespula (2)*



CONFIRMATORY CHARACTERS FOR THE GENERA OF VESPOIDEA

Eumenes 9–15 mm. Punctate with brownish hairs. Male antennae hooked at tip. Eyes converge below. Uncommon.

Gymnomerus 8–11 mm. Head and thorax very hairy. Propodeum hollowed out. Male antennae curled at tip. Legs partly reddish. Uncommon.

Odynerus 8–12 mm. Stout; Femur 2 and Coxa 2 with teeth. Male antennae curled at tip.

Symmorphus 7–15 mm. Thorax hairy. Female with 2 pits behind ocelli.

Microdynerus 6–8 mm. Like a small *Odynerus* (see above), with pointed tegulae. Uncommon.

Ancistrocerus 6–16 mm. Fairly stout, male with tip of antennae hooked.

Euodynerus 9–11 mm. Reddish yellow on legs. Female with two pits behind ocelli. Rare.

Pseudepipona 9–11 mm. Legs reddish, and red marks on sides of A1. Female with one pit behind ocelli. Uncommon.

Vespa 18–35 mm. Thorax red-brown; head mainly yellow, pale haired; abdomen mainly yellow with brown marks. Clypeus hairy on lower part only.

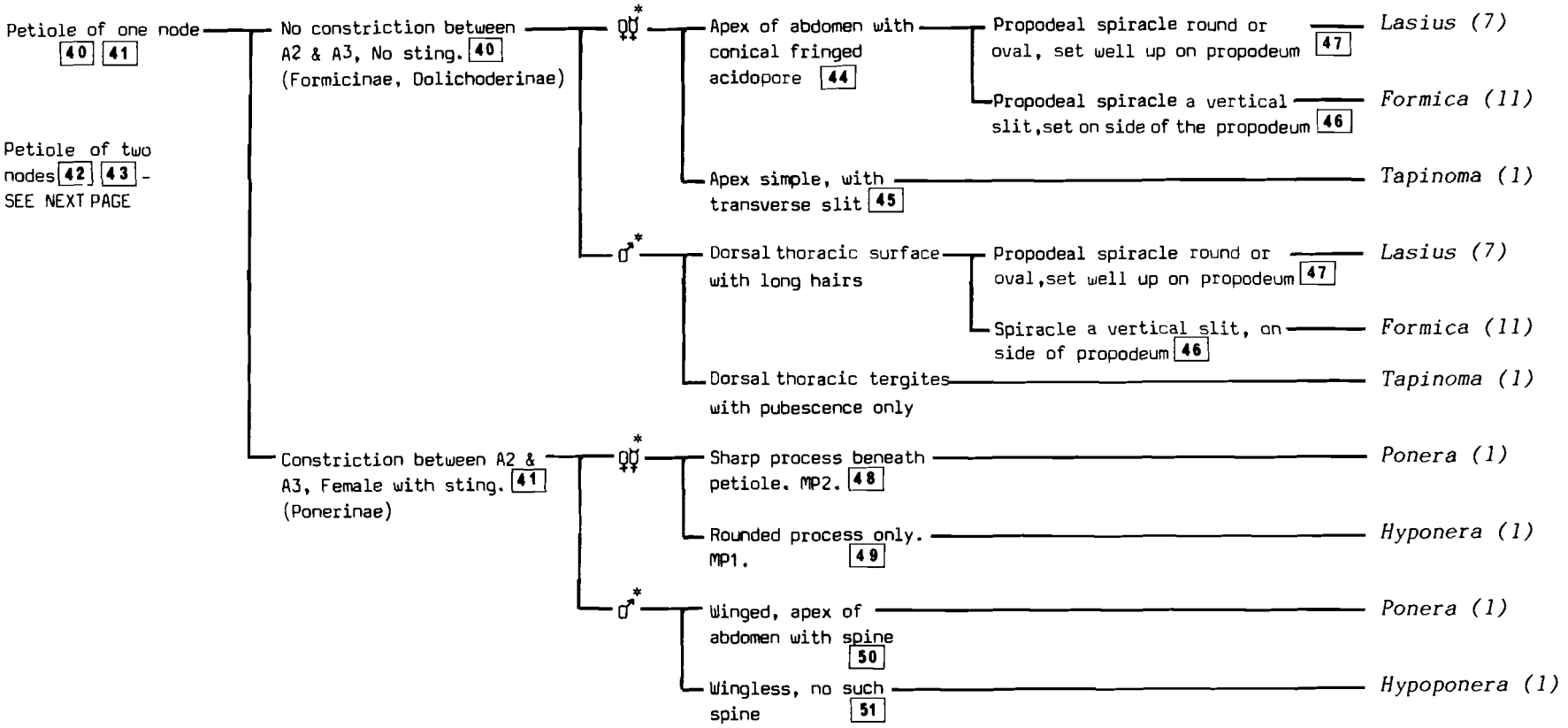
Vespula 9–20 mm. Clypeus hairy. Pronotum simple. Hard to distinguish from *Dolichovespula*.

Dolichovespula 10–18 mm. Clypeus hairy. Pronotum with vertical keel laterally.

FURTHER READING AND IDENTIFICATION

Can be identified to species using Richards (1980), or with the keys in a general biology of the group by Spradbery (1973) which also contains useful background material. A review by Richards (1971) is also valuable.

FORMICOIDEA (Continued on next page)



* *SEX AND CASTE IN ANTS.* ♀ - *QUEEN* ☿ - *WORKER* ♂ - *MALE*

Note that winged forms will nearly always be males; wingless forms will nearly always be workers. Queens are rare, and will usually be larger; though winged initially, they then lose their wings but retain traces of wing-base attachments on the thorax. If uncertain CHECK : ☿ *and* ♀ *have 6 visible abdominal segments,* ♂ *have 7.*

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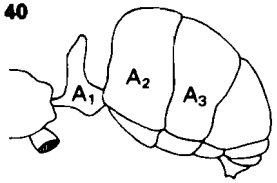

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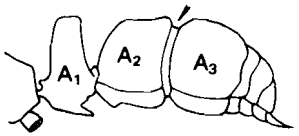

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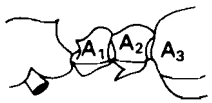

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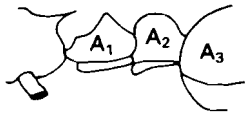

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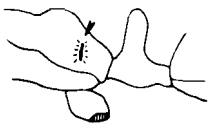

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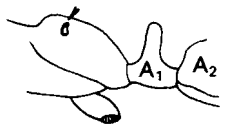

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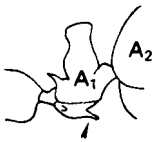

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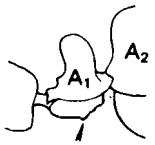

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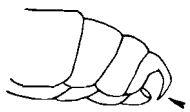

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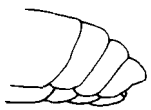


CONFIRMATORY CHARACTERS FOR THE GENERA OF FORMICOIDEA

Ponera Worker brown, hairy, extremities reddish-yellow, head black, MP2, 3–3½ mm. Queen similar, 4–4½ mm. Male black, legs brown, 3½–4 mm. Locally common.

Hypoponera Worker variable yellow-brown, pubescent MP1, 2½–3½ mm. Queen similar, 3½–4 mm. Male wingless, reddish yellow, eyes small and low-set, 3½ mm. Locally common, near buildings.

Lasius* Variable; yellow, brown or black, size differing with species. MP6. LP4. Queen large, worker and male similar sizes.

Formica* Variable size and colour according to species. MP6, LP4. Queen and male large, workers smaller.

Tapinoma Worker black, legs brown, tarsi yellow. Whitish pubescence, no long hair. MP6, LP4. 2½–4 mm. Queen similar, 4½–6 mm. Male similar, 3½–5 mm. Locally common.

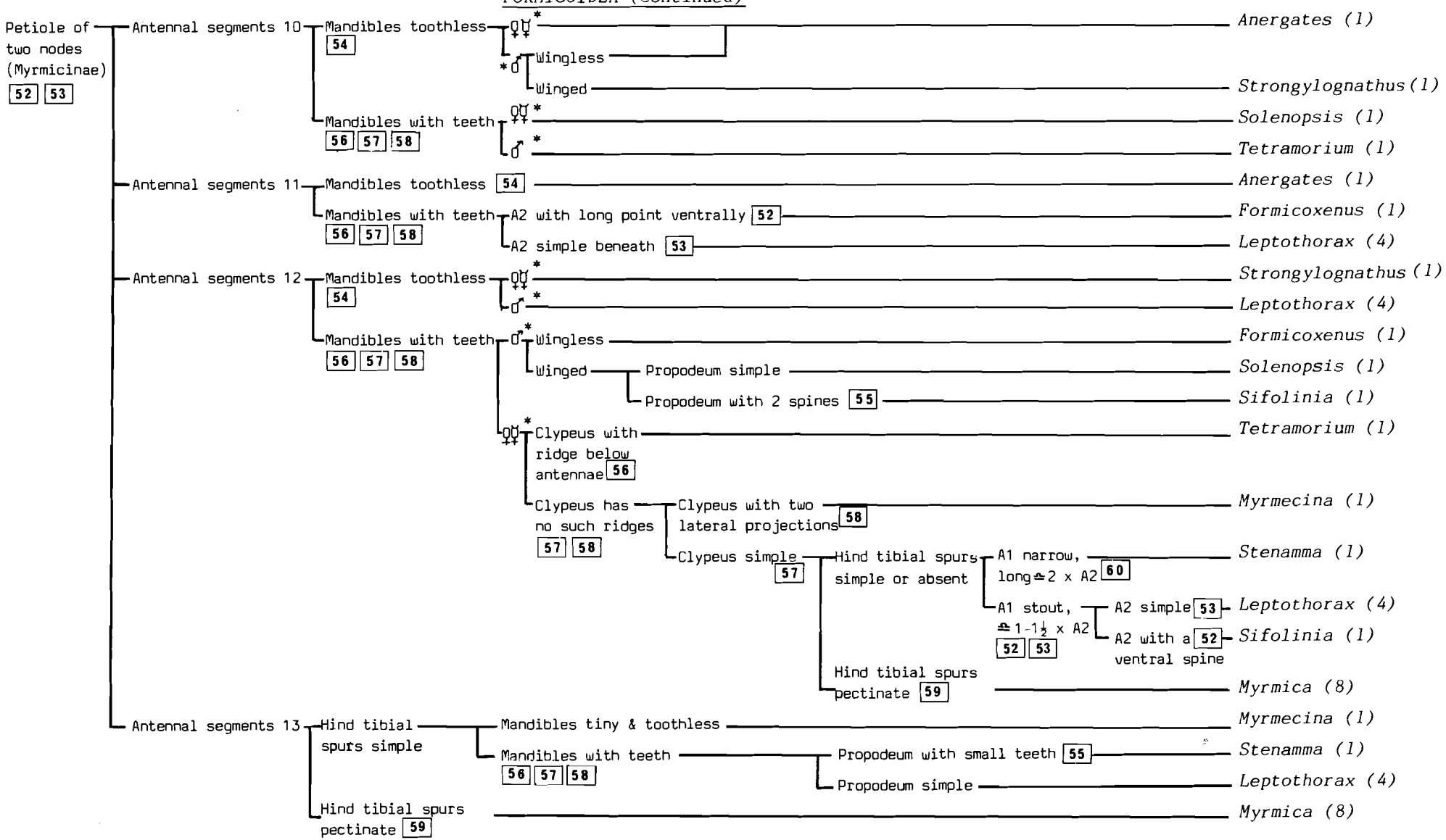
*The common genera *Lasius* and *Formica* are not easy for beginners to separate. However, *Lasius* workers are usually less than 4 mm long (but not always), and coloured yellow or orange, while *Formica* workers are usually more than 4 mm long and reddish or brownish. (The exception is *L. fuliginosus* which is larger and brown, but fortunately with prominent round spiracles).

FURTHER READING AND IDENTIFICATION

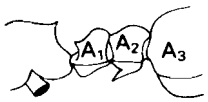
Details are given overleaf

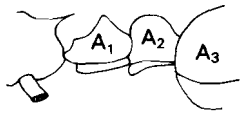
KEY D

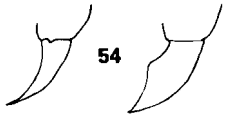
FORMICOIDEA (continued)



* *SEX AND CASTE IN ANTS. See footnote on previous page.*

52 

53 

54 

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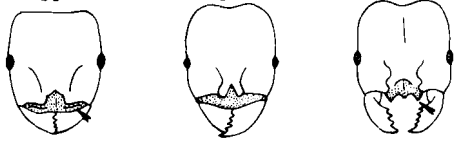
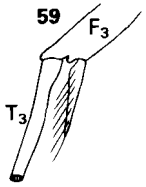
56 57 58 

59 

60

Anergates No worker caste. Queen black-brown, extremities yellow, dull and punctate, MP2, LP1, sting reduced, eyes large, $2\frac{1}{2}$ mm. Male dull yellow, wingless, abdomen bent under. Rare, usually found in nests of *Tetramorium*.

Strongylognathus Worker yellowish, mandibles long, top of head concave. $2\frac{1}{2}$–$4\frac{1}{2}$ mm. Queen and male similar, slightly larger. Uncommon, usually in nests of *Tetramorium*.

Solenopsis Worker reddish-yellow, A3 darker, shiny, hairy, MP2, LP2. $1\frac{1}{2}$–3 mm. Queen brown, extremities yellow, 6–$6\frac{1}{2}$. Male black, extremities yellowish, 4–5 mm. Locally common.

Tetramorium Worker black-brown, extremities yellowish, head and thorax longitudinally striate, MP4, LP3, $2\frac{1}{2}$–4 mm. Queen brown, reddish extremities, 7–8 mm. Male as queen, $5\frac{1}{2}$–6mm, 3rd antennal segment elongate. Locally common.

Formicoxenus Worker reddish-yellow, shiny, ocelli often absent, MP4, LP3, $3\frac{1}{2}$–$4\frac{1}{2}$ mm. Queen darker, $3\frac{1}{2}$ mm. Male similar, 3 mm. Locally common, usually in nests of *Formica*.

Leptothorax Worker reddish-yellow. Extremities darker, MP5, LP3, $3\frac{1}{2}$–$4\frac{1}{2}$ mm. Queen darker, 4–5 mm. Male black-brown, tibiae and tarsi yellow. $4\frac{1}{2}$–$5\frac{1}{2}$ mm. A fairly common introduced ant, *Monomorium pharaonsis,* may key out here; the workers are tiny (2–3 mm) and pale yellow. Only found in heated buildings.

Sifolinia No worker caste. Queen yellowish. 3–$3\frac{1}{2}$ mm. Male brown, shiny, $3\frac{1}{2}$ mm. Rare, usually in nests of *Myrmica*.

Myrmecina Worker black-brown. Hairy, extremities reddish, thorax longitudinally rugose, MP4, LP3, 3–$3\frac{1}{2}$ mm. Queen similar, wings darkened, 4–$4\frac{1}{2}$ mm. Male black, shiny and hairy, eyes and ocelli large. $3\frac{1}{2}$–4 mm. Locally common.

Stenamma Worker reddish-yellow, lighter extremities, frons longitudinally rugose, MP4, LP3, $3\frac{1}{2}$–4 mm. Queen similar, 4–5 mm. Male black-brown, extremities yellow, 4 mm. Locally common.

Myrmica Worker reddish-yellow-brown, eyes large, antennae clubbed, MP6, LP4, 4–$4\frac{1}{2}$ mm. Queen similar, $5\frac{1}{2}$–7 mm. Male black-brown, extremities lighter, 5–$5\frac{1}{2}$ mm.

FURTHER READING AND IDENTIFICATION

Ants can be identified to species with Bolton & Collingwood (1975), or with Collingwood (1979); the latter covers the Scandinavian fauna, but is better illustrated. Background reading is provided in Sudd (1966), Brian (1977), and on a world-wide basis in Wilson (1971).

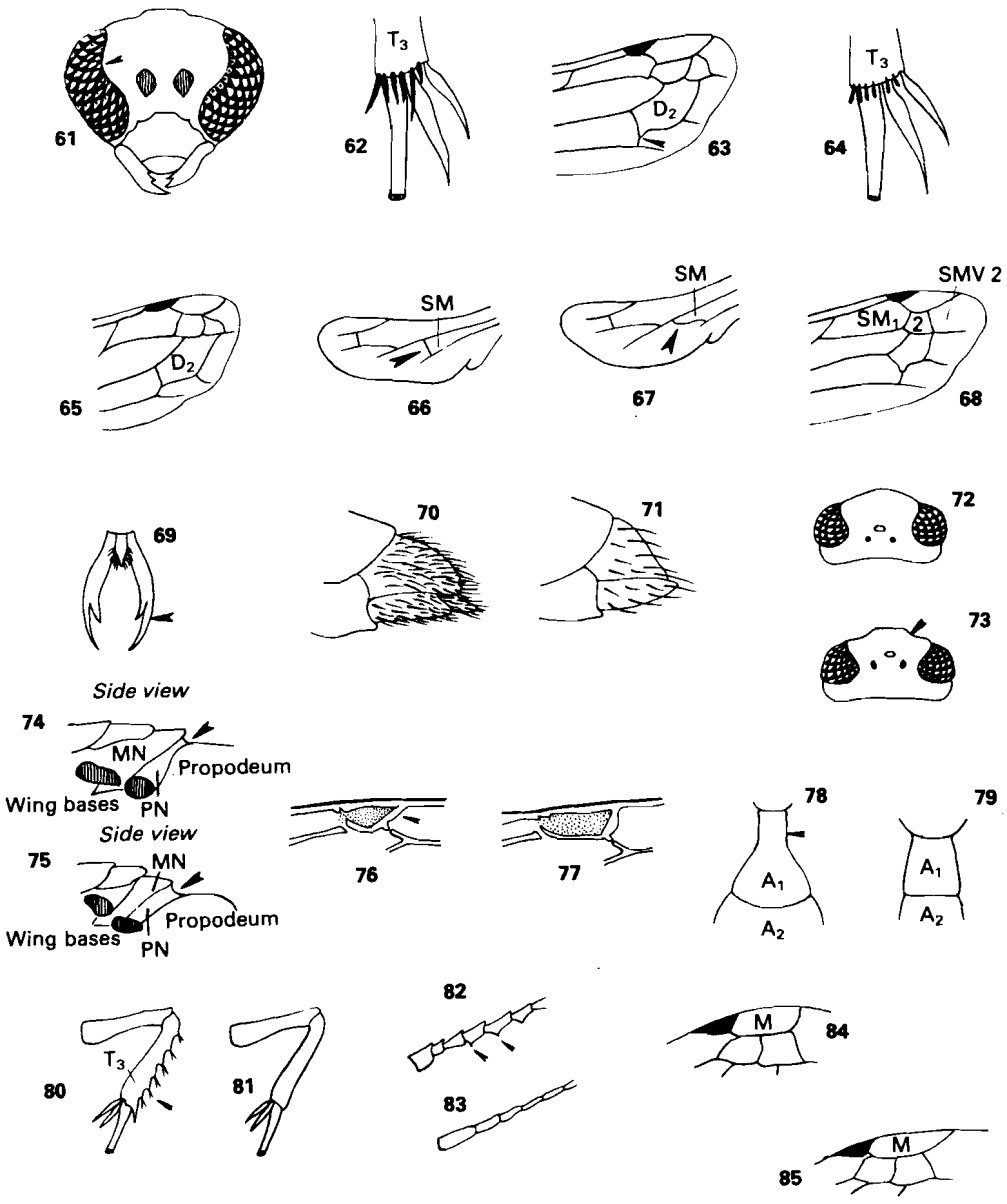
KEY E — POMPILOIDEA

- Eyes strongly converge below, kidney-shaped (Ceropalinae) 61 → *Ceropales (2)*
- Eyes not so
  - Hind tibia with spreading spines as well as spurs. Cell D2 with a downward-pointing projection. 62 (Pompilinae) 63
    - SM cell of hind wing closed by a straight perpendicular vein 66 → *Homonotus (1)*
    - SM cell of hind wing enclosed by a curved vein 67
      - Antennae set at or below lower eye margin. Only 2 SM; SMV2 straight 68 → *Aporus (1)*
      - Antennae set higher, 3SM, or if 2 then SMV2 arched
        - ♂*
          - ALL claws bifurcate 69
            - Thorax and A1 with flat scale-like hairs → *Episyron (1)*
            - No such hairs → *Anoplius (5)*
          - Some not (toothed or simple) → *Evagetes (3)*
        - ♀*
          - ALL claws bifurcate 69 → *Anoplius (5)*
          - Some not (toothed or simple)
            - Anal tergite with stout bristles 70 → *Evagetes (3)*
            - Anal tergite with fine flexible hair 71
              - Frons evenly rounded. Pronotum narrow at midline, almost hidden by metanotum from above 72 74 → *Evagetes (3)*
              - Frons raised at middle. Postnotum broad and shining; not hidden by metanotum from above 73 75
                - Black, grey pubescence all over → *Pompilus (1)*
                - Not pubescent all over, and some red parts
                  - Stigma wide with curved outer margin. Black, red legs 77 → *Agenioideus (1)*
                  - Stigma short, narrow, straight-edged. Black, with A1 - A3 red 76 → *Arachnospila (7)*
  - Hind tibiae with spurs only, ± shorter parallel teeth. Cell D2 simple, straight-sided. (Pepsinae) 64 65
    - Petiolate, A1 parallel-sided initially 78 → *Auplopus (1)*
    - Not so, A1 with gradually diverging sides 79
      - ♀ hind tibia serrated below 80; ♂ antennal segments simple 83
        - M cell blunt at tip 84 → *Cryptocheilus (1)*
        - M cell acute at tip 85
          - Propodeum with blue sheen, stigma fairly broad 85 → *Caliadurgus (1)*
          - Propodeum dull. stigma narrow 65 → *Priocnemis (13)*
      - ♀ hind tibia smooth 81; ♂ antennal segments dilated below 82 → *Dipogon (3)*

* *SEX IN WASPS*

♀ has 12 antennal segments
♂ has 13 antennal segments

♀ has 6 abdominal segments visible
♂ has 7 abdominal segments visible



CONFIRMATORY CHARACTERS FOR THE GENERA OF POMPILOIDEA

Episyron 6–13 mm. Black, thorax and tergites white-flecked. Legs with red marks.

Ceropales 4–10 mm. Claws all sharply angled. Legs very long, especially 3rd. Some red ± white markings. Female with obvious ovipositor. Locally common.

Auplopus 6–10 mm. All black. A1 narrow. Wings clear. Female with blunt projection on clypeus. Uncommon.

Cryptocheilus 7–15 mm. Black, A1-n red. Propodeum with net-like wrinkles. Uncommon.

Caliadurgus 6–11 mm. Female black, A1-n red, dark 3-pointed mark on forewing, spine on T1. Male black, wings clear, anal tergite pale. Locally common.

Priocnemis 4–20 mm. Black, A1-n red. Wings brownish with a clear white spot near tip.

Dipogon 5–13 mm. All black, wings with two dark transverse bands.

Homonotus 6–9 mm. Black, silver tipped tergites, thorax and propodeum sometimes reddish. Antennae short, tibial spurs pale. Rare.

Aporus 3–8 mm. Female has only 2 SM cells. Prothorax broad, femur 1 thick. Tergites partly red in female, black in male. Rare.

Anoplius 5–15 mm. Black, ±A1-n red. Dark anal bristles in female.

Evagetes 5–13 mm. Black ±A1-n red. Only 2 SM cells in 1 of the 3 spp.

Pompilus 5–14 mm. Black, pale grey pubescence all over. Usually coastal.

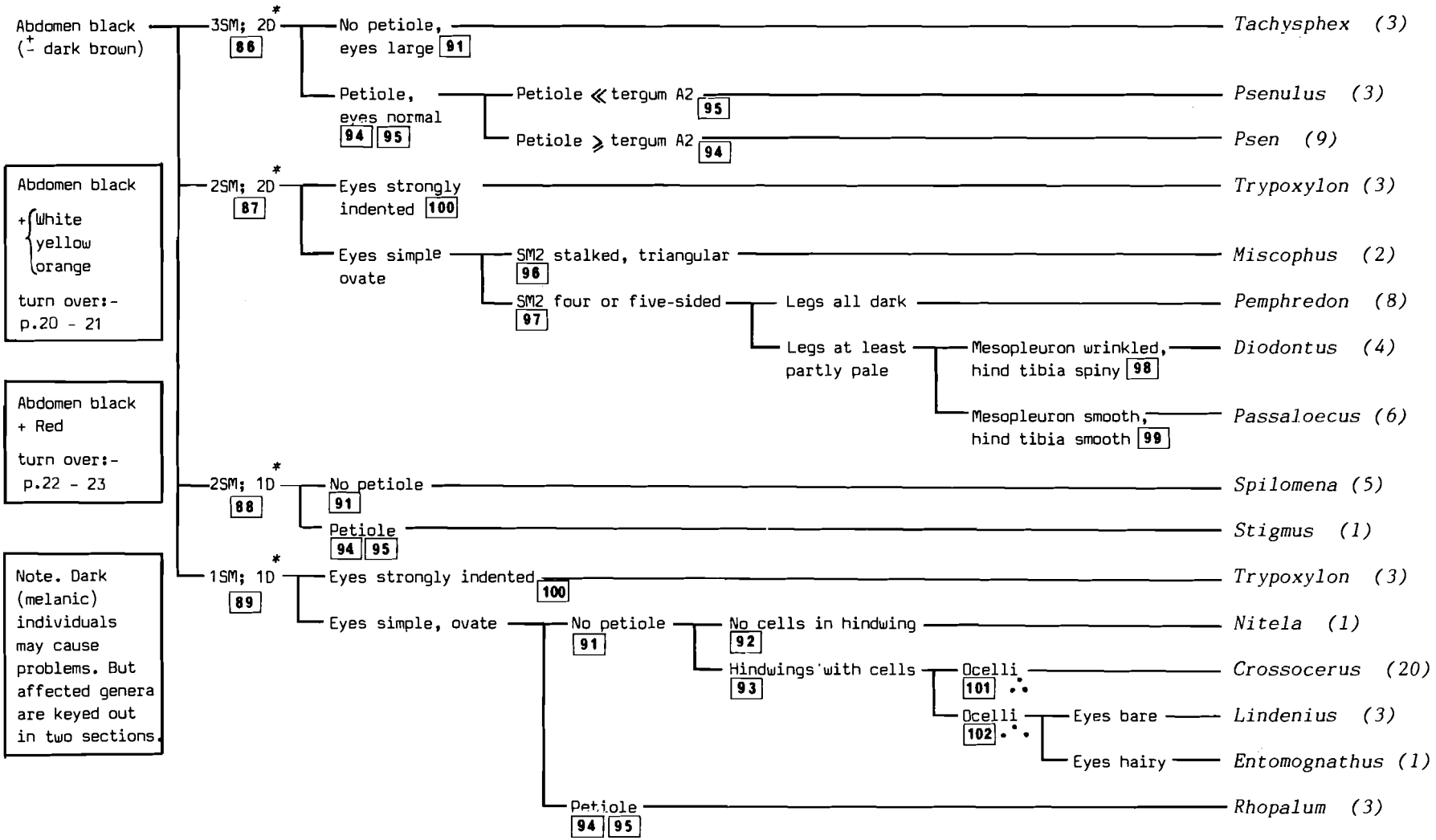
Agenioideus 3–7 mm. Black. Stigma large. Oval fleck at top of eye margins. Legs may be partly reddish. Uncommon.

Arachnospila 5–15 mm. Black ± red ± white. Wings usually brownish, especially around edges. Claw 1 toothed in female, forked in male.

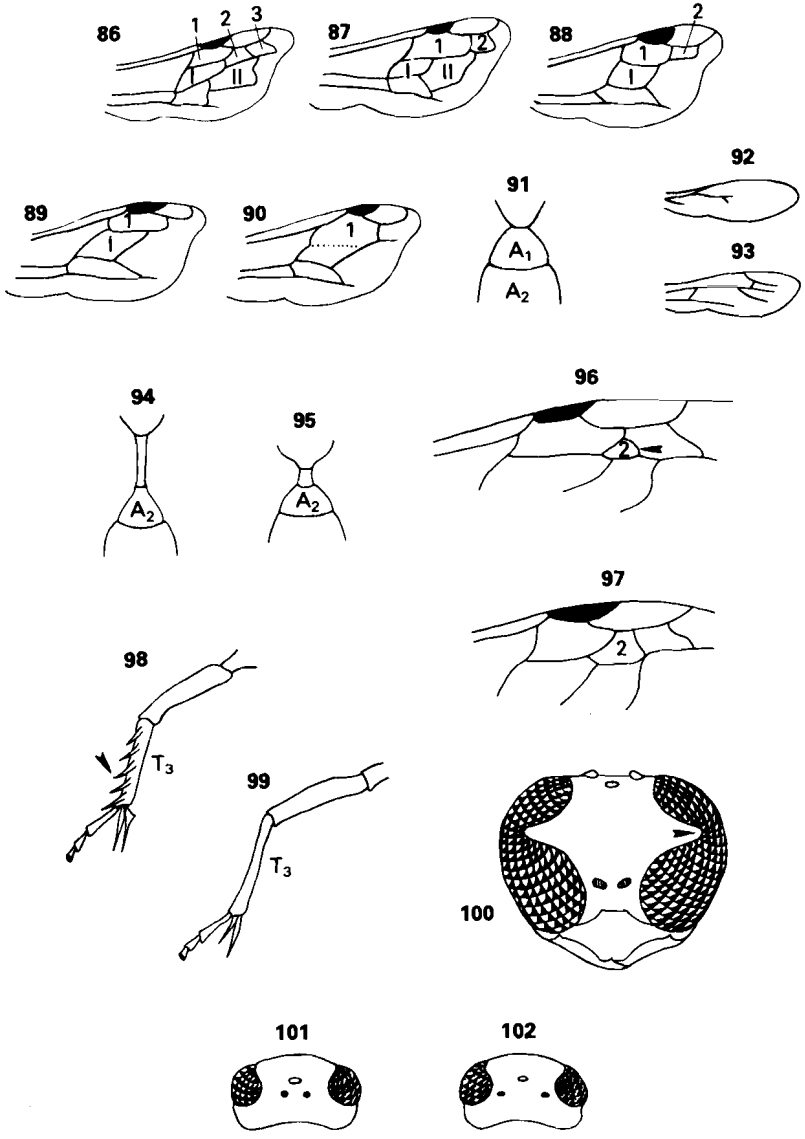
FURTHER READING AND IDENTIFICATION

A very difficult group to identify satisfactorily, the only modern key being in German (Wolf, 1972) though this is comprehensive and well illustrated. It also contains useful biological information, as do early works by Saunders (1896) and Perkins (1920), though in these the classification is outdated.

KEY F — *SPHECOIDEA (continued on next pages)*



* *IMPORTANT. Wing venation can be variable between left and right wings. CHECK BOTH WINGS.*



CONFIRMATORY CHARACTERS FOR THE GENERA OF SPHECOIDEA

Diodontus 4–9 mm. SM1 elongate. Very short petiole. Propodeum very coarsely pitted.

Pemphredon 6–12 mm. Head and thorax with long hairs, head large. SM1 long. Petiole moderately long.

Passaloecus 3–7 mm. Abdomen quite slender, head short. Very short petiole.

Stigmus $3\frac{1}{2}$–6 mm. Stigma large. Mandibles yellow, antennae pale. Uncommon.

Spilomena $2\frac{1}{2}$–3 mm. Stigma very large. Antennae inserted very low down. Locally common.

Psen 7–12 mm. Black (subgenera *Psen, Mimumesa*) or black & red (subgenus *Mimesa*). Mandibles long, frons usually with ridge or tubercles.

Psenulus 6–9 mm. Mandibles short and stout. Thorax stout, petiole short. RV1→SM2, RV2→SM3.

Tachysphex 5–10 mm. Eyes diverge ventrally, large. RV1 & 2→SM2. Thorax stout. Posterior ocelli oval, flat. Lower face silvery.

Miscophus 4–6 mm. RV1→SM1, RV2→SM2. Head large, propodeum large. Rare.

Trypoxylon 6–12 mm. Abdomen long, narrow. M cell long. Clypeus silvery.

Entomognathus 3–6 mm. Stout, with short yellow legs. Propodeum short, abdomen broad. No petiole.

Lindenius 4–8 mm. Clypeus silvery. Mesopleuron with carina. No petiole. Legs partly yellow.

Rhopalum 4–8 mm. Slender and long, petiole with swelling. Face silvery, head large and square. No carina on mesopleuron. Legs partly white/yellow.

Crossocerus 4–12 mm. Eyes converge ventrally, antennae set close together. Clypeus silvery. Variable yellow colour, some nearly all black.

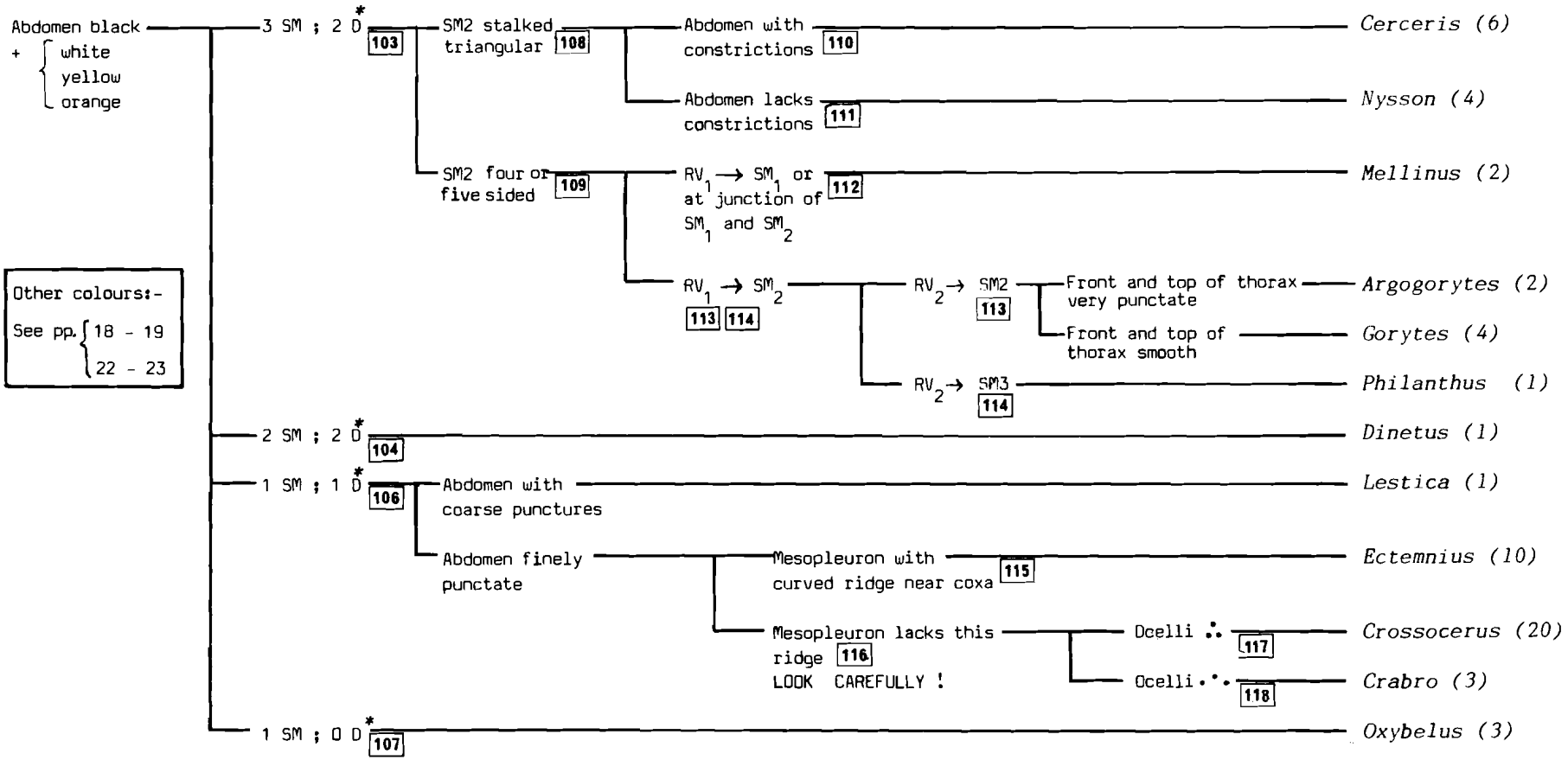
Nitela $2\frac{1}{2}$–5 mm. Eyes converging above. Sub-discoidal cell of forewing open. Rare.

FURTHER READING AND IDENTIFICATION

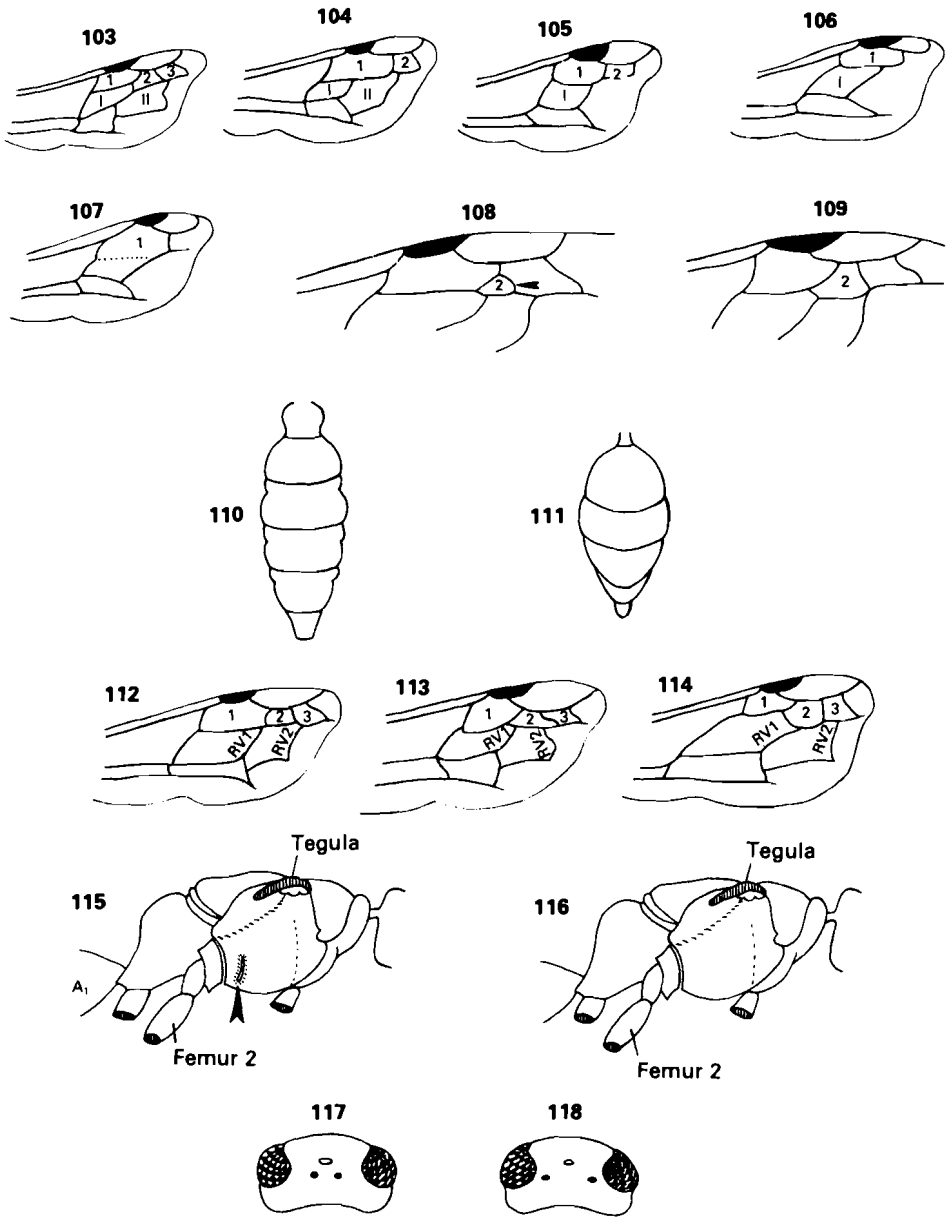
See last key in this section.

KEY F

SPHECOIDEA (continued on next page)



** IMPORTANT. Wing venation can be variable between left and right wings. CHECK BOTH WINGS.*



CONFIRMATORY CHARACTERS FOR THE GENERA OF SPHECOIDEA

Cerceris 8–16 mm. Head large, eyes diverge ventrally. Antennae set high, frons keeled, face with yellow pattern. No petiole.

Philanthus 10–15 mm. Head and thorax large. Eyes diverge ventrally. Face with white or yellow marks. No petiole. Locally common.

Argogorytes 9–14 mm. Propodeum short. Base of A2 strongly swollen. Antennae all black.

Gorytes 8–13 mm. Antennae often yellow/brown. Eyes converge ventrally. RV1&2→SM2. Wings often tinted near stigma.

Nysson –12 mm. Propodeum with 2 stout spines. Eyes converge ventrally. No petiole. RV1&2→SM2.

Mellinus 8–15 mm. Petiole thick. Amount of yellow very variable. Propodeum long. RV1→SM1, RV2→SM3.

Dinetus 6–8 mm. Eyes diverge ventrally, ocelli round. Comblike hairs on tarsi 1. M cell small. Very rare.

Oybelus 6–9 mm. Broad. Spine on propodeum, wing-like structures on metanotum. Eyes diverge ventrally, face and clypeus silvery. SM1 divided from D1 by faint 'vein'.

Crabro 8–16 mm. Eyes converge ventrally. Clypeus silvery. Abdomen long. Male forelegs often very expanded.

Ectemnius 7–21 mm. Eyes converge ventrally, clypeus silver or gold. Scape of antenna large, partly yellow, male with only 12 segments. Mandibles large, usually yellow-marked.

Lestica 8–12 mm. Whole body punctate. Eyes converge. Male antenna only 12 segments. Male with long 'neck' and expanded metatarsus 1. Very rare.

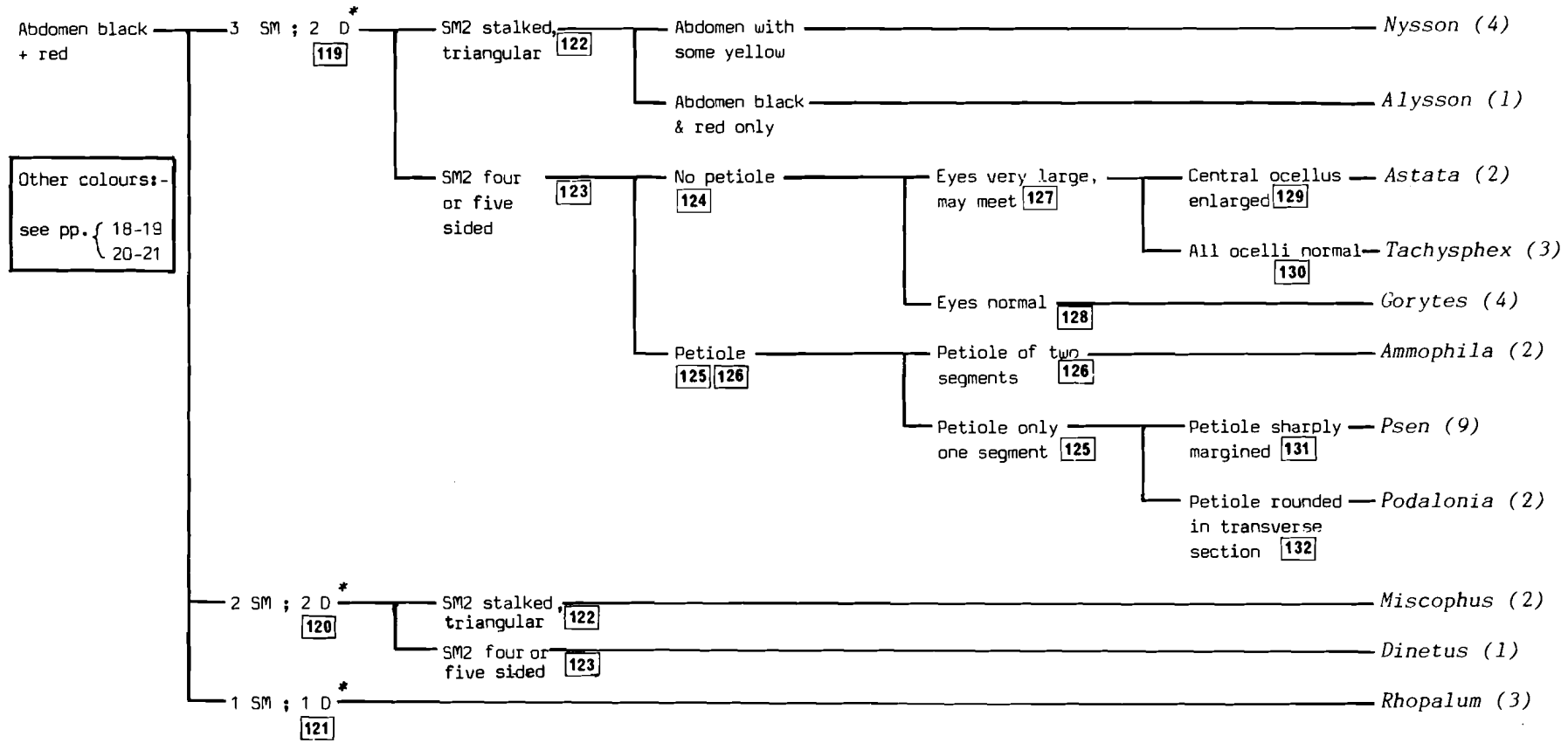
Crossocerus 4–12 mm. Eyes converge ventrally, antennae set close together. Clypeus silvery. Variable yellow colour, some nearly all black.

FURTHER READING AND IDENTIFICATION

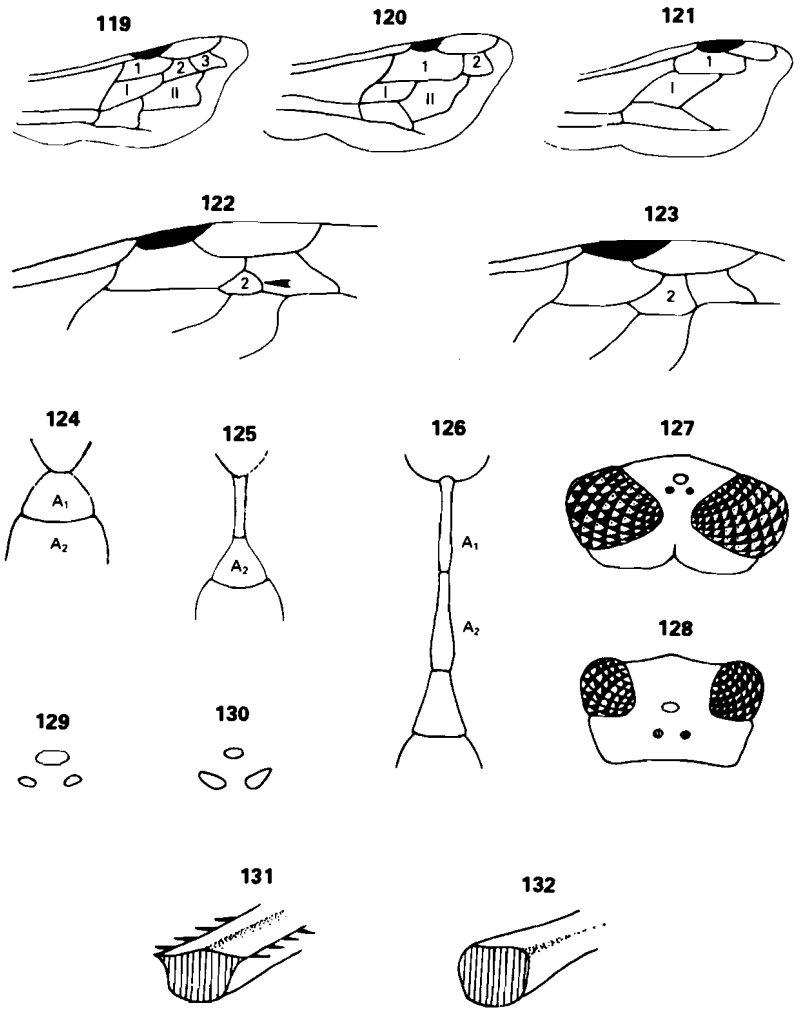
See last key in this section.

KEY F

SPHECOIDEA (continued from previous pages)



** IMPORTANT. Wing venation can be variable between left and right wings. CHECK BOTH WINGS.*



CONFIRMATORY CHARACTERS FOR THE GENERA OF SPHECOIDEA

Podalonia 14–20 mm. Thorax and head stout and hairy. Female mandibles large. Tongue fairly long.

Ammophila 15–22 mm. Very long and thin, eyes large. Mandibles large, tongue long. Thorax slender, not very hairy.

Psen 7–12 mm. Black (subgenera *Psen, Mimumesa*) or black & red (subgenus *Mimesa*). Mandibles long, frons usually with ridge or tubercles.

Gorytes 8–13 mm. Antennae often yellow/brown. Eyes converge ventrally. RV1&2→SM2. Wings often tinted near stigma.

Nysson 7–12 mm. Propodeum with 2 stout spines. Eyes converge ventrally. No petiole. RV1&2→SM2.

Alysson 6–9 mm. Pronotum long and coarsely sculptured. Eyes converge ventrally. RV1→SM1, RV2→SM2. Rare.

Astata 7–12 mm. Male eyes meet above. Eyes diverge ventrally. Base of antenna thick. RV1 & 2→SM2. Tibia 3 spiny.

Dinetus 6–8 mm. Eyes diverge ventrally, ocelli round. Comblike hairs on tarsi 1. M cell small. Very rare.

Miscophus 4–6 mm. RV1→SM1, RV2→SM2. Head large, propodeum large. Rare.

Rhopalum 4–8 mm. Slender and long, petiole with swelling. Face silvery, head large and square. No carina on mesopleuron. Legs partly white/yellow.

Tachysphex 5–10 mm. Eyes diverge ventrally, large. RV1 & 2→SM2. Thorax stout. Posterior ocelli oval, flat. Lower face silvery.

FURTHER READING AND IDENTIFICATION

May be readily identified to species using Richards (1980), Lomholdt (1976) or Beaumont (1964); of these the Fennoscandian work by Lomholdt may be found particularly simple to use. A good deal of background material is to be found in early works by Hamm (1926), Hamm & Richards (1930), and in the writings of Fabre; more recent studies are included in the books by Evans & Eberhard (1973), Bohart & Menke (1976), and Yeo & Corbet (1983). The last work includes keys and coloured plates.

KEY G

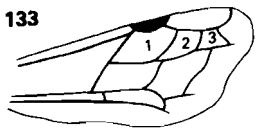
APOIDEA (continued on next page)

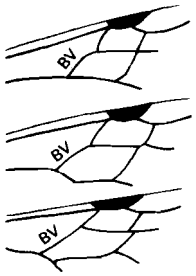
- 3 SM cells [133]
  - BV arched with a definite region of sharper curvature. (CHECK BOTH WINGS). [134]
    - Almost hairless
      - Metallic blue — *Ceratina (1)*
      - Black & red — *Sphecodes (16)*
    - Hairy, black/grey/brown
      - Hair bands of abdomen at tips of segments [137]
        - D1 & D2 same length [139] — *Colletes (8)*
        - D1 ≫ D2 [140] — *Halictus (6)*
      - Hair bands absent, or at base of segments [138] — *Lasioglossum (32)*
  - BV straight or with a continuous gentle curve (CHECK BOTH WINGS). [135] [136]
    - D1 ≏ rhomboid, not much elongated [141]
      - SM2 ≪ SM3 [143] (CHECK BOTH WINGS).
        - Almost hairless, blue metallic — *Ceratina (1)*
        - Hairy, brownish
          - Apex of antenna pointed; Hindwing JL ⩾ SM [145] [146] — *Andrena (65)*
          - Apex diagonally truncate, Hindwing JL < SM [147] [148] — *Melitta (4)*
      - SM2 ⩾ SM3 [144] [149] (CHECK BOTH WINGS).
        - SM2 ≏ quadrate [144] — *Colletes (8)*
        - SM2 long and triangular [149] — *Apis (1)*
    - D1 elongate proximally, not nearly rhomboid [142]
      - SM2 ≪ SM3 [143]
        - Hairy bees
          - Black with white lateral spots — *Melecta (2)*
          - Brownish, hair in bands or all over — *Andrena (65)*
        - Almost hairless, black ± red or yellow — *Nomada (28)*
      - SM2 ⩾ SM3 [144] [149]
        - Streak across SM1, usually pigmented [150]
          - ♂ *
            - Tips of genitalia dark, hind tibiae with few long hairs — *Bombus (18)*
            - Tips of genitalia pale, hind tibiae with many short hairs — *Psithyrus (6)*
          - ♀ *
            - Hind tibiae convex, hairy [151] — *Psithyrus (6)*
            - Hind tibiae concave, shiny, forming pollen basket [152] — *Bombus (18)*
        - No such streak
          - ⩾ 10mm, hairy, D2 long [153] — *Anthophora (5)*
          - ⩽ 10mm, white hair, spots, [154] D2 normal — *Epeolus (2)*

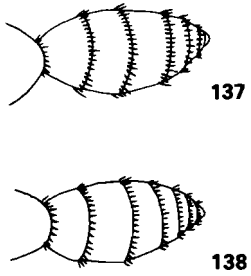
Only 2SM cells - see pp.26-27

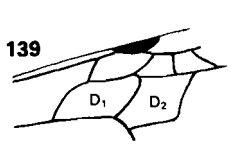
* SEX AND CASTE IN BUMBLE-BEES

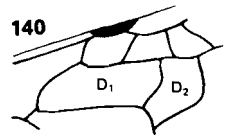
♂ *13 antennal segments*
♀♀♂ *12 antennal segments*
♂ *Genital capsule - no sting*
♀ *Sting present*

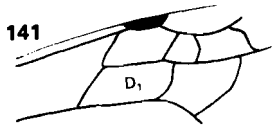


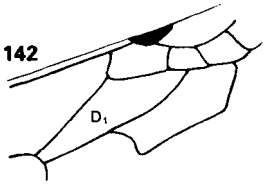


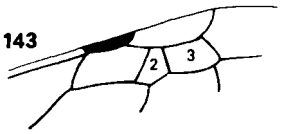


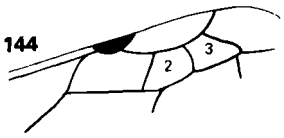


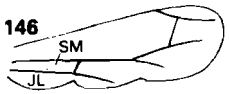


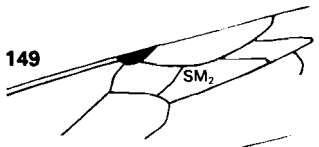


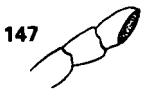


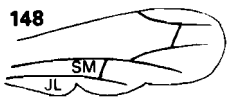


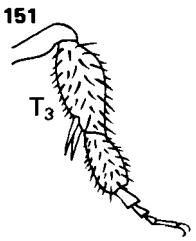


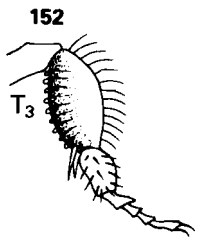


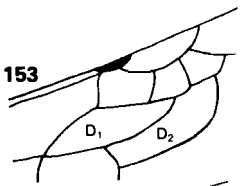


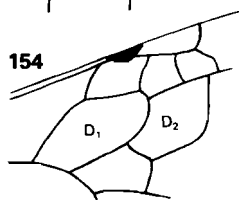












Conventionally, the bees are divided into groups by tongue structure and length, but often die with the tongue concealed or distorted and other mouthparts difficult to see; therefore, this key depends largely on wing venation, and uses the mouthparts only for confirmation as far as possible.

Note that colours given here usually refer to the cuticle and this ground colour may be obscured by a covering of dense pale-coloured hairs.

CONFIRMATORY CHARACTERS FOR THE GENERA OF APOIDEA

Colletes 8–15 mm. Hairy, often with denser bands on abdomen. Tongue short and bifid.

Sphecodes 5–12 mm. Black and red shiny. Tongue moderate length, ovate.

Halictus & Lasioglossum 5–13 mm. Very variable, brown/grey/black, ±hair bands. Tongue moderate length, ovate. Female with distinct longitudinal groove on last segment.

Andrena 5–16 mm. Very variable in colour. Antennal segment 3»2 usually. Tongue moderate, fairly pointed. Female with velvety area near inner eye rim.

Melitta 12–15 mm. Tongue moderate, pointed. Like large *Andrena*. Not common.

Nomada 4–15 mm. Black, usually with yellow bands, wasplike. Tongue long. Male clypeus hairy. Antennal segment 2 very short.

Epeolus 5–10 mm. White spots on abdomen, ±red on scutellum, legs and mandibles, otherwise black. Tongue long. MP1, LP4. Locally common.

Ceratina 6–7 mm. Blue, shining, punctate. Clypeus and labrum white in male. Uncommon.

Melecta 13 mm. Black, with brown/grey hair, lateral white spots on abdomen. MP5, LP4. Tongue long. Uncommon.

Anthophora 10–16 mm. Black, very hairy. Male clypeus and labrum pale, legs often fringed with long hairs. MP6, LP2–4. Tongue long, or very long.

Bombus 10–22 mm. Dark, very hairy. Pollen basket in females, long face often with pale hair tuft in males. MP2, LP4. Tongue long, or very long.

Psithyrus 15–22 mm. Dark, very hairy. Wings usually quite dark. No pollen basket in female, male face quite short. MP2, LP4. Tongue long or very long.

Apis 13–17 mm. Variable orange-brown. Eyes large and hairy. M cell very long. Tongue long, MP1, LP4.

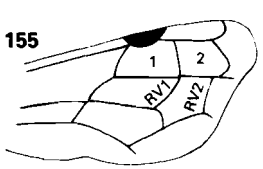
FURTHER READING AND IDENTIFICATION

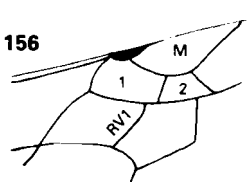
See notes on next page.

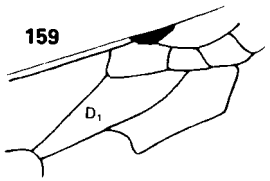
KEY G

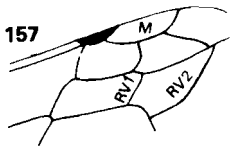
APOIDEA (continued from previous page)

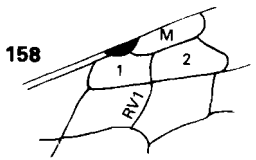
- 2 SM cells [155]
  - RV1 → SM1, or exactly at junction of SM1/SM2. CHECK BOTH WINGS CAREFULLY [155] [156]
    - SM2 < SM1 [156]
      - Very hairy — *Dasypoda (1)*
      - Almost hairless — *Hylaeus (12)*
    - SM2 ≏ SM1 [155]
      - M cell truncate [158] — *Panurgus (2)*
      - M cell pointed [156] — *Dufourea (2)*
  - 3 SM cells :- see pp.24-25
  - RV1 → SM2 even if only just so. CHECK BOTH WINGS CAREFULLY. [157]
    - RV2 → beyond SM2, or at junction [157]
      - D1 elongate, abdomen with yellow spots [159] — *Anthidium (1)*
      - D1 normal, abdomen black ± pale tips to segments [160] — *Stelis (3)*
    - RV2 → SM2 [155]
      - M cell pointed on wing margin [161]
        - Mesonotum not very hairy
          - A1 with transverse ridge right across [163] — *Heriades (1)*
          - No such ridge, may be partial line [164]
            - A1 smooth & shining — *Macropis (1)*
            - A1 dull & punctate
              - Antennae partly pale, abdomen oval and stout — *Rophites (1)*
              - Antennae all dark, Abdomen elongate — *Chelostoma (2)*
        - Mesonotum with long dense hairs — *Dasypoda (1)*
      - M cell not pointed, not ending on wing margin [162]
        - Eyes hairy — *Coelioxys (7)*
        - Eyes bare
          - M cell blunt [157] — *Panurgus (2)*
          - M cell rounded [162]
            - Mandibles close below labrum [165] — *Eucera (2)*
            - Mandibles close over labrum, so it is hidden [166]
              - Sparsely hairy, narrow, black bee.
                - A1 with transverse ridge across [163] — *Heriades (1)*
                - A1 without ridge [164] — *Chelostoma (2)*
              - Fairly stout, hairy and/or metallic bee
                - Feet lack an arolia; MP2 [167] [169A] — *Megachile (8)*
                - Feet with prominent arolia; MP4 [168] [169B] — *Osmia (9) & Hoplitis (3)*

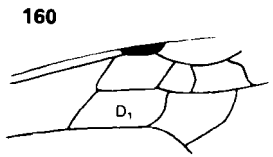


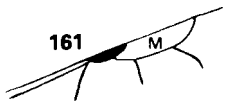


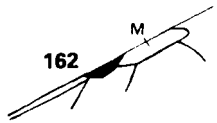


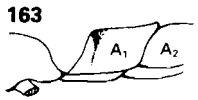


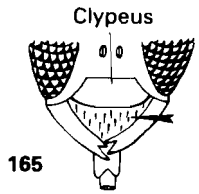


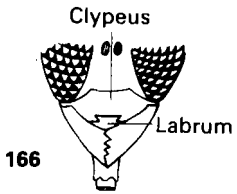


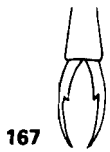


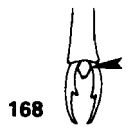


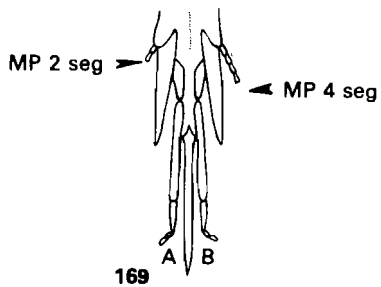












CONFIRMATORY CHARACTERS FOR THE GENERA OF APOIDEA

Hylaeus 4–8 mm. Black, sparsely hairy, ±yellow legs. Male face usually white or yellow, female has pale spots on face. Tongue short and bifid.

Macropis 9–10 mm. Abdomen black and shining, T3 and F3 dilated in male, T3 and metatarsus 3 in female. Male face yellowish. Legs pale-haired in male, brown-haired in female. Locally common.

Dasypoda 15–16 mm. Head and thorax with long pale hairs, almost white in male. Tongue quite long. T3 extremely densely hairy. Locally common, on sand.

Panurgus 7–10 mm. Black and shiny, ±bright hairs, e.g. on legs. Tongue quite long. Locally common.

Dufourea 6–7 mm. Black & shiny, with pale brown hairs. Tongue long. Very rare.

Rophites 9 mm. Dull black, with brown hair. Tongue long. Very rare.

Chelostoma 6–10 mm. Black, fairly shiny, long abdomen. MP3, LP4. Locally common.

Heriades 6–7 mm. Black, very punctate, abdomen curved under and with ridges on segments 1 and 2 below. MP3, LP4. Very rare.

Coelioxys 10–15 mm. Brownish, abdomen long and almost triangular, spiny at end in male. Scutellum toothed. MP2, LP4. Tongue long. Locally common.

Megachile 9–18 mm. Black, with dense hairs on thorax±abdomen. Head and mandibles large. MP2, LP4. Tongue long. ♂ front tarsi often dilated.

Osmia & Hoplitis 7–15 mm. Very variable colour and degree of hairiness; metallic, dull or shiny. Tongue very long, MP4, LP4. (British species of these two genera cannot be separated except by experts).

Stelis 6–9 mm. Black, punctate, ±pale spots or lines on abdomen. Tongue long. MP2–3, LP4. Uncommon.

Anthidium 11–16 mm. Black, with variable yellow spots on head and abdomen. Tongue long; MP2, LP4. Locally common.

Eucera 15–16 mm. Black, dense hair on head & thorax, bands on abdomen in female. Male antennae long. Tongue long. Locally common.

FURTHER READING AND IDENTIFICATION

There is regrettably no single modern work which allows identification of the British bees to species though a Royal Entomological Society handbook will be available soon. The very early keys provided by Saunders (1896) and by Schmiedeknecht (1930) often prove useful, and keys (some rather difficult) to individual genera are available as follows:

Andrena, Nomada Perkins (1919)
Halictus, Lasioglossum & Sphecodes Perkins (1922)
Megachile Perkins (1925)
Colletes, Epeolus Richards (1937), Guichard (1974)
Bombus, Psithyrus Richards (1927), Alford (1972)

Background information is available in Shuckard (1866), the works of Fabre, and in Step (1932); there is also an extensive scattered bibliography on bees in the scientific literature. Works on social bees (Michener, 1974) and on bumble-bees (Heinrich, 1979) are also available, whilst O'Toole & Raw (1984) contains useful material on the natural history of bees.

AIDGAP Project publications

Groups which have been covered by other publications are:

Brown seaweeds
A field key to the British brown seaweeds by Sue Hiscock (1979). This guide should enable anybody to identify the majority of British macroscopic (larger than 1 cm) brown seaweeds in the field, most of them to species level. Littoral, sublittoral and rare species are all included. A full glossary is appended, and numerous thumbnail sketches are incorporated in the text to help ease-of-use. All plants are fully illustrated and an introductory section describing the ecology of the brown seaweeds will help in interpreting patterns of distribution on the seashore.

Diatoms
An illustrated guide to the diatoms of British coastal plankton, by J. B. Sykes. This guide, published in 1981, will help the non-specialist to gain entry to the microscopic world of the phytoplankton. Following introductory sections on the ecology of marine diatoms, a key is provided to some sixty forms most likely to be encountered in plankton samples from British coastal waters.

Diptera
A key to the families of British Diptera, by D. M. Unwin (1981). Although most people learn to recognise and distinguish between such groups as the 'house flies' and 'daddy longlegs', the Diptera have, as a whole, remained a closed book to all but a few. This key should enable anybody to identify adult flies to their family; this is often sufficient for any survey of the group, but a full list of references is appended to guide the investigator's further enquiries.

Crabs
A key to the crabs and crab-like animals of British inshore waters, by John & Marilyn Crothers (1983). This up-to-date guide is the compilation of many people's work, adapted and re-written for the non-specialist in the light of the authors' experience. It should enable anybody to identify all the crabs (hermit and porcelain crabs included) they may find on British sea shores, and whilst skin-diving or dredging close inshore. All species are fully illustrated.

Slugs
A field key to the slugs of the British Isles, by R. A. D. Cameron, B. Eversham & N. Jackson (1983). There can be few places in the British Isles where slugs are not encountered regularly. It is surprising therefore that the group has received so little attention but this may have been due to the lack of a simple field key. This guide should help to alleviate these problems; it is designed to enable the user to identify the majority of slugs to species level without having to kill or dissect the specimens. Each species is illustrated in a series of colour plates and details of ecology and distribution are provided throughout.

Beetles
A key to the families of British Coleoptera (and Strepsiptera) by D. M. Unwin (1984). This key is both up-to-date and comprehensive, including over 90 families of beetles and the 3 families of Strepsiptera which are found in the British Isles. The emphasis on characters which are easily observed will make this an ideal key for those with little experience in this group. Full details of taxonomy are included, and the detailed lists of families' confirmatory characters and identification handbooks will provide a foundation for further investigation into this group, one of the largest insect orders.

Field Studies, the Journal of the Field Studies Council, published a number of keys before the AIDGAP project was under way. These include:

British Water Plants, by S. M. Haslam, C. A. Sinker and P. A. Wolseley (1975: revised and reprinted, 1982).
Revised Field Key to the Invertebrate Fauna of Stony Hill Streams, by Margaret Redfern (1975).
Key to the Genera of British Seaweeds, by W. E. Jones (1962).

Any of these papers may be purchased when visiting a FSC Field Centre, or they can be ordered through the AIDGAP address shown opposite, from which a full FSC publications list can also be obtained.

THIS GUIDE

Bees, ants and wasps–the Aculeates–are a common sight throughout the whole of the British Isles, some examples being found in most habitats from early spring through to autumn. However, although many people will be able to recognise the more familiar types the vast majority of aculeates remain unknown to all but a few specialists. This key should enable anybody looking at this group for the first time to put a generic name to the specimens they encounter. The keys were "AIDGAP" tested; copies were sent to 150 users–including specialist academics and 'novices' alike–and this version was revised in the light of their comments. The result is a key which combines scientific accuracy with maximum ease-of-use.

An introductory section explains how the aculeates can be distinguished from other closely related groups and provides a brief review of their ecology and life-history. More detailed notes on ecology and habits are given for each genus in the following keys, and the references listed at the end of each key will enable the reader to progress further with their investigation of this complex and fascinating group.

The other AIDGAP keys already published are:–

Hiscock, Sue (1979). *A field key to the British brown seaweeds* (Phaeophyta).

Sykes, J. B. (1981). *An illustrated guide to the diatoms of British coastal plankton.*

Cameron, R. A. D., Eversham, B. and Jackson, N. (1983). *A field guide to the slugs of the British Isles.*

Crothers, John and Crothers, Marilyn (1983). *A key to the crabs and crab-like animals of British inshore waters.*

Unwin, D. M. (1984). *A key to families of British Coleoptera* (Beetles) *and Strepsiptera.*

AIDGAP keys and other *Field Studies* offprints are available through the post from:–
"Field Studies", Nettlecombe Court, Williton, Taunton, Somerset TA4 4HT,
or from:–
E. W. Classey Ltd., PO Box 93, Faringdon, Oxon SN7 7DR.

A complete list of FSC publications, titles and prices, is available from either address.

Occasional Publication No. 7 (S16)
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The front cover shows a bumble bee *Bombus hortorum*, taken by J. E. Bebbington.

Printed in Great Britain by Henry Ling Ltd., at the Dorset Press, Dorchester, Dorset