

BEES, ANTS AND WASPS THE BRITISH ACULEATES

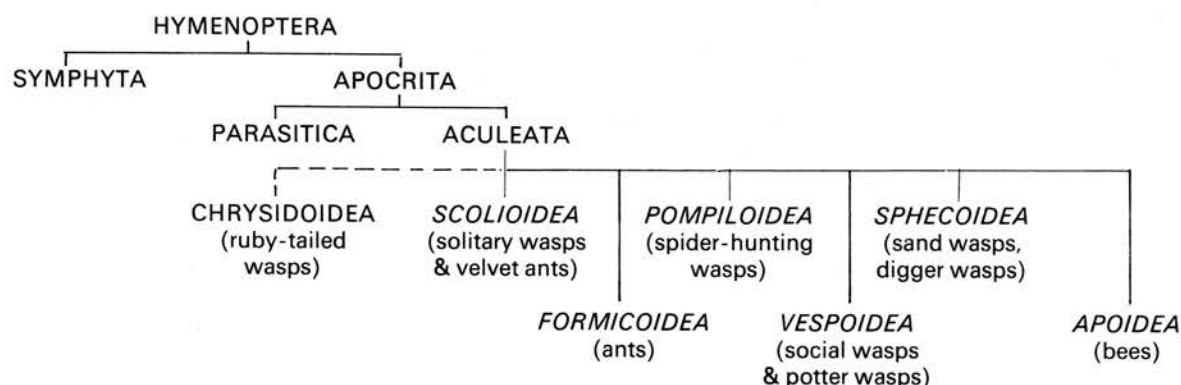


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INTRODUCTION

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 Chrysididae, 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.

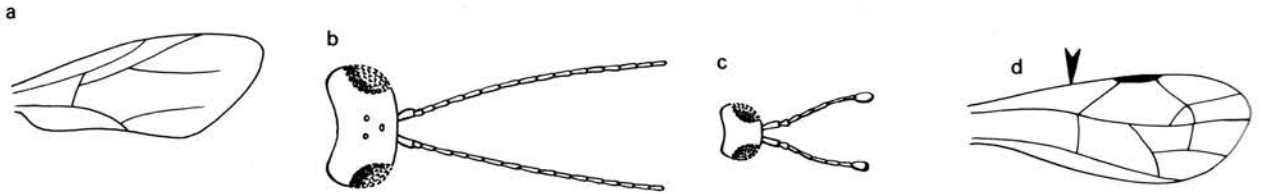
RECOGNISING ACULEATES

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

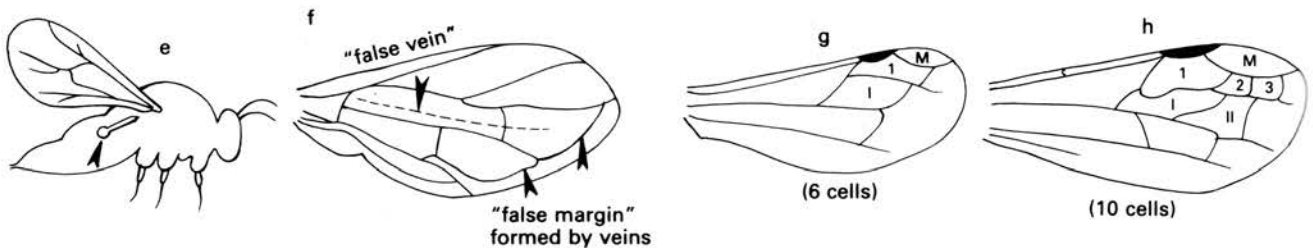
1. A *narrow waist*, sometimes elongated as a 'petiole'. The waist actually comes between the first and second true abdominal segments, so that the first segment of the abdomen becomes effectively joined to the thorax and is given the special name of 'propodeum' (see Illustrations and Glossary on pages 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

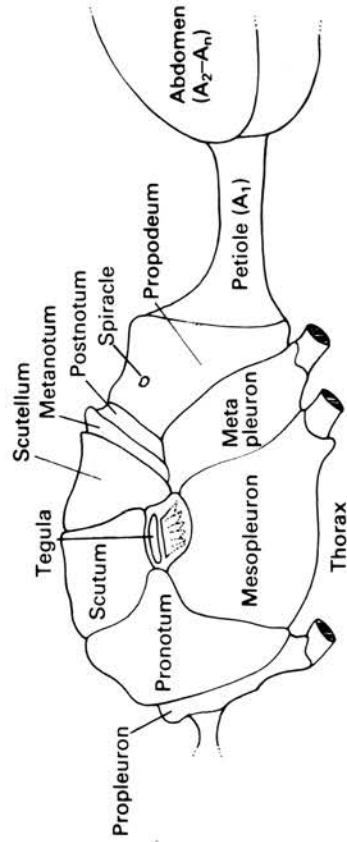
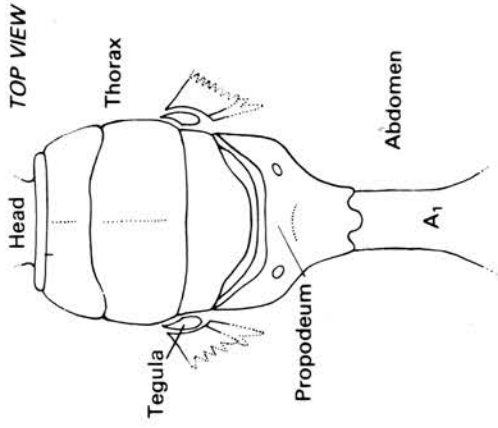
1. If you have become interested in the aculeates, you might consider joining the British 'Bees, Wasps & Ants Recording Scheme' (BWARS). This group seeks to map and record out native species, and would be grateful for your cooperation; they may also help with identification. Requests for information 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 sub-sections 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

REFERENCES

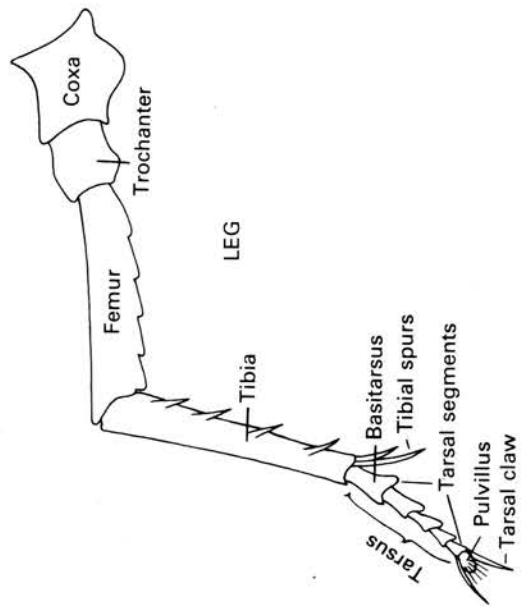
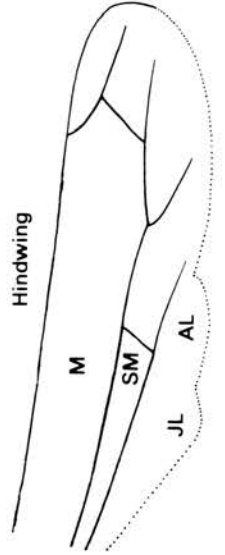
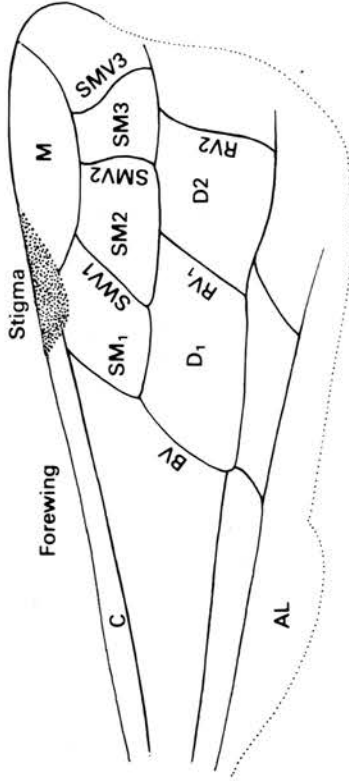
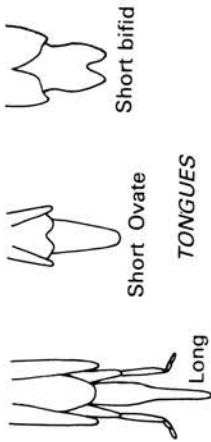
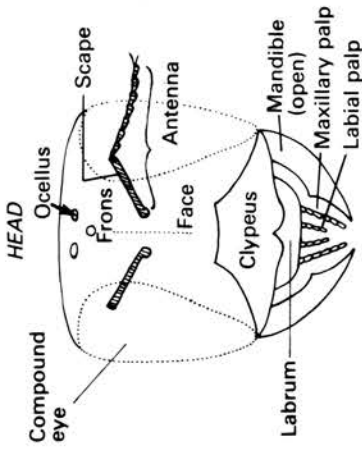
- ALFORD, D.J. (1972). Guide to the British species of Bumble Bees. *Entomologist's Gazette*, 23, 17–24.
- BEAUMONT, J. de., (1964). Hymenoptera: Sphecidae. *Insecta Helvetica Fauna*. 3, 1–169.
- BOHART, R.M and MENKE, A.S. (1976). *Sphecid Wasps of the World*. University of California Press, Los Angeles.
- BOLTON, B. and COLLINGWOOD, C.A. (1975). Hymenoptera, Formicidae. *Handbooks for the identification of British Insects* Vol. VI, Part 3(c), 1–34.
- BRIAN, M.V. (1977). *Ants*. Collins, New Naturalist, London.
- BRIAN, M.V. (1983). *Social Insects: Ecology and Behavioural Biology*. Chapman and Hall, London.
- CHINERY, M. (1976). *A Field Guide to the Insects of Britain and Northern Europe*. 2nd Edition. Collins, London.
- COLLINGWOOD, C.A. (1979). The Formicidae (Hymenoptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* 8, 1–174.
- EDWARDS, R. (1980). *Social Wasps—their biology and control*. Rentokil, East Grinstead.
- EVANS, H.E. and EBERHARD, M.J.W. (1973). *The Wasps*. Newton Abbot, David & Charles.
- FABRE, J.H. 'Bramble-bees and others', 'The Hunting Wasps', 'The Mason Wasps', 'More Hunting Wasps', and 'The Mason Bees'. Translated by A.T. de Mattos, B. Miall. Hodder & Stoughton, London & New York.
- GUICHARD, K.M. (1974). *Colletes halophila* Verhoeff (Hymenoptera: Colletidae), and its *Epeolus* parasite, with a key to the British species of *Colletes* Latr. *Entomologist's Gazette* 25; 195–199.
- HAMM, A.H. (1926). The biology of British Crabronidae. *Transactions of the Royal Entomological Society, London*. 1926, 297–331.
- HAMM, A.H. and RICHARDS, O.W. (1930). The biology of the British fossorial wasps of the families Mellinidae, Gorytidae, Philanthidae, Oxybelidae, and Trypoxylidae. *Transactions of the Royal Entomological Society, London*. 78, 95–131.
- HEINRICH, B. (1979). *Bumblebee Economics*. Harvard University Press, Cambridge, Mass.
- HYMENOPTERIST'S HANDBOOK. Ed. B.A. Cooper *et al.*, 1945. Reprinted 1969, University of Leeds.
- IWATA, K. (1976). *Evolution of Instinct—Comparative Ethology of the Hymenoptera*. Smithsonian Institution, Washington, D.C., and Amerind Publishing Company, New Delhi.
- KROMBEIN, K.V. (1967). *Trap-nesting wasps and bees—Life histories, nests and associates*. Smithsonian Press, Washington D.C.
- LOMHOLDT, O. (1975–1976). The Sphecidae (Hymenoptera) of Fennoscandia and Denmark. Parts I & II. *Fauna Entomologica Scandinavica* 4, 1–452.
- LUBBOCK, J. (1888). *Ants, Bees and Wasps*. Kegan, Paul, Trench & Co., London.
- MALYSHEV, S.I. (1968). *Genesis of the Hymenoptera and the phases of their Evolution*. (Translation). Methuen and Co., London.
- MICHENER, C.D. (1974). *The social behaviour of the Bees*. Belknap Press, Harvard, Cambridge, Massachusetts.

- O'TOOLE, C. and RAW, A. (1984). *A murmur of bees*. Oxford University Press.
- PERKINS, R.C.L. (1919). The British species of *Andrena* and *Nomada*. *Transactions of the Royal Entomological Society, London*. 1919, 218–316.
- PERKINS, R.C.L. (1920). Notes on the British Psammodiidae (Pompilidae). *Entomologist's Monthly Magazine* 56, 32–38.
- PERKINS, R.C.L. (1922). The British species of *Halictus* and *Sphecodes*. *Entomologist's Monthly Magazine* 58, 46–52, 94–101.
- PERKINS, R.C.L. (1925). The British species of *Megachile*, with descriptions of some new varieties from Ireland, and of a species new to Britain from F. Smith's collection. *Entomologist's Monthly Magazine* 61, 95–101.
- RICHARDS, O.W. (1927). The specific characters of the British bumble-bees (Hymenoptera). *Transactions of the Royal Entomological Society, London*. 1927, 233–268.
- RICHARDS, O.W. (1937). A study of the British species of *Epeolus* Latr. and their races, with a key to the species of *Colletes* (Hymenoptera, Apidae). *Transactions of the Society of British Entomologists* 4, 89–130.
- RICHARDS, O.W. (1971). The biology of social wasps (Hymenoptera, Vespidae). *Biological Reviews, Cambridge*. 46, 483–528.
- RICHARDS, O.W. (1980). Scoliidae, Vespoidea and Sphecoidea; Hymenoptera, Aculeata. *Handbooks for the Identification of British Insects*. VI (3b) 1–118.
- SAUNDERS, E. (1896). *The Hymenoptera Aculeata of the British Islands*. Lovell, Reeve & Co., London.
- SCHMIEDEKNECHT, O. (1930). *Hymenoptera Nord-und Mittel-Europas*. Fischer, Jena.
- SHUCKARD, W.E. (1866). *British Bees*. Lovell, Reeve & Co., London.
- SPRADBERY, J.P. (1973). *Wasps*. Sidgwick & Jackson, London.
- STEP, E. (1932). *Bees, Wasps, Ants and allied Insects*. Wayside and Woodland Series, Warne, London.
- SUDD, J.H. (1966). *An Introduction to the behaviour of Ants*. Edward Arnold, London.
- WILSON, E.O. (1971). *The Insect Societies*. Belknap Press, Harvard, Cambridge, Massachusetts.
- WOLF, H. (1972). Hymenoptera; Pompilidae. *Insecta Helvetica Fauna*. 5, 1–176.
- YEO, P.F. and CORBET, S.A. (1983). *Solitary Wasps*. Cambridge University Press.

ACULEATE STRUCTURE AND TERMINOLOGY



SIDE VIEW



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 A₁-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 membranous 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

> ≥ Greater than; greater than or equal to

< ≤ Less than; less than or equal to

≈ Approximately the same as

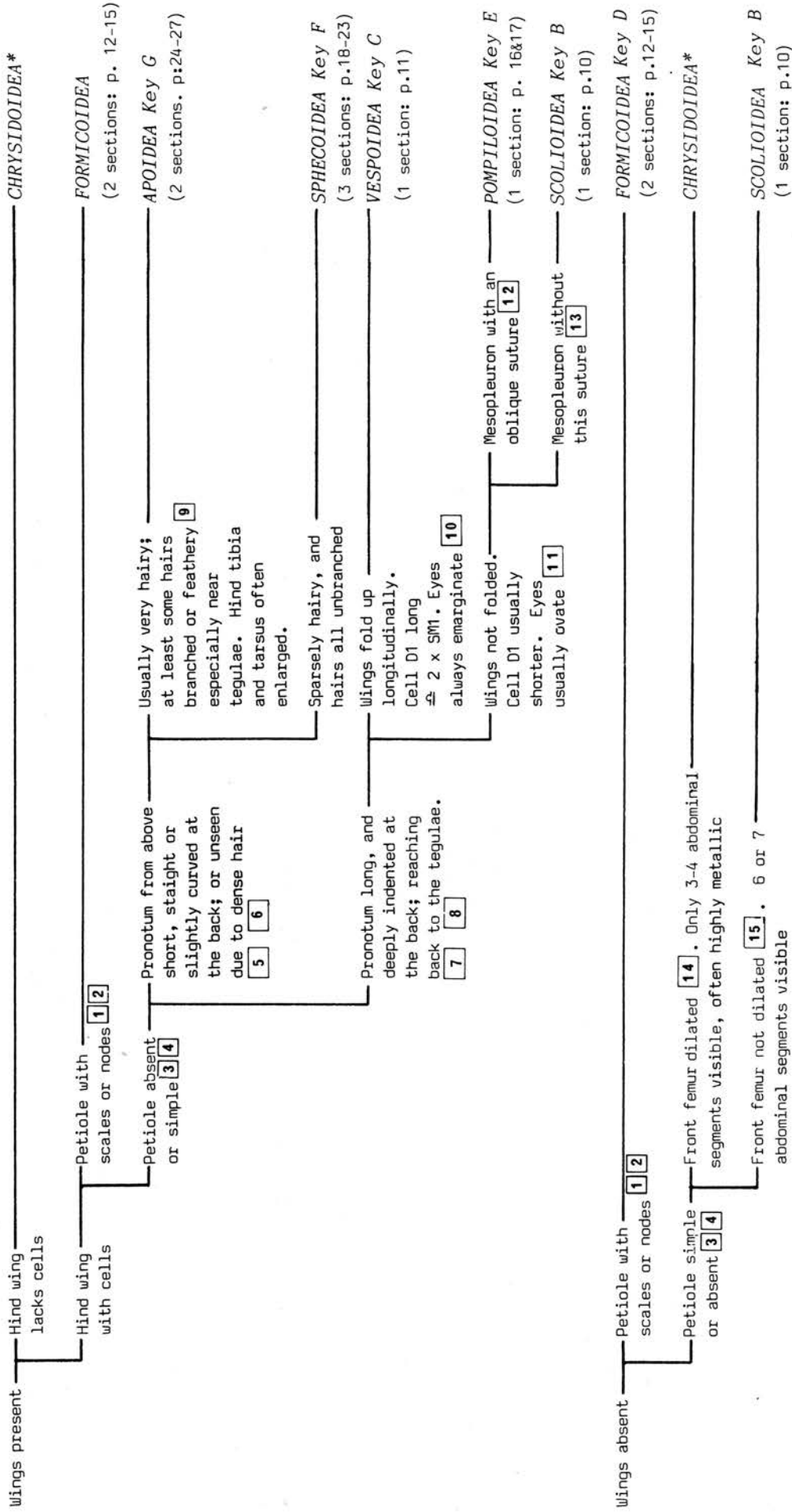
→ eg. RV₁ → SM₂. The arrow indicates that vein RV₁ meets the margin of cell SM₂, rather than SM₁ or SM₃. Always look carefully and check both wings.

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 TO THE SUPERFAMILIES

KEY A



* *Chrysoidea* 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 \pm red markings. 6 genera, 8 species.

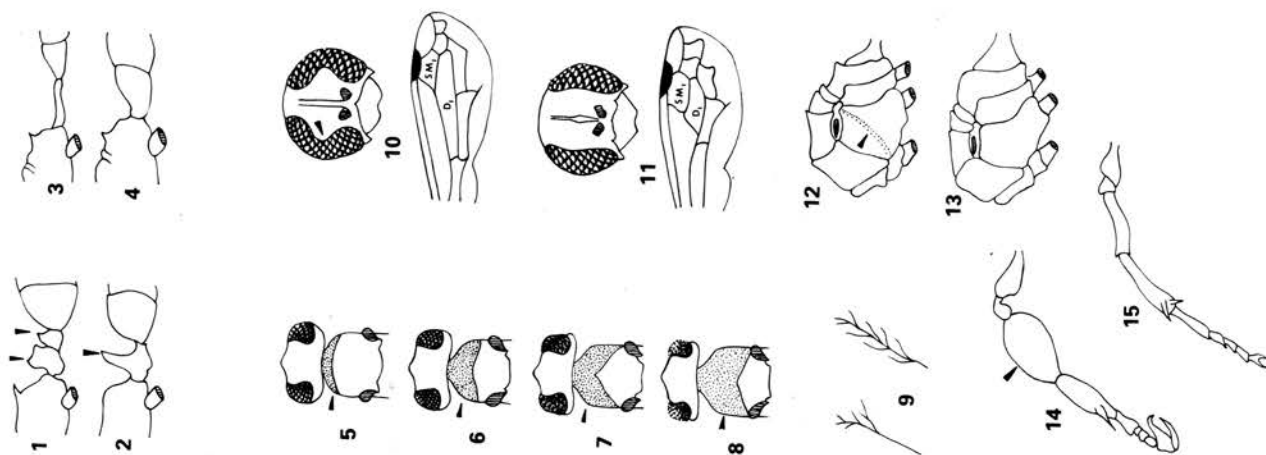
Formicoidea The ants. Mostly small, all with scales or nodes on the petiole. Found in all habitats, feeding the larvae on animal matter, seeds, fungi, etc., according to species; some are social parasites of other ants. Structurally variable, with a caste system of queens, males and workers (these are sometimes of two types). May be sexed by the number of visible abdominal segments (♀ and ♂ , ♂ 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*, *Creumatogaster*, *Iridomyrmex*, *Camponotus* and *Monomorium*, and additional introductions from the indigenous keyed genera *Tapinoma* and *Tetramorium* (mostly to be found around heated buildings).

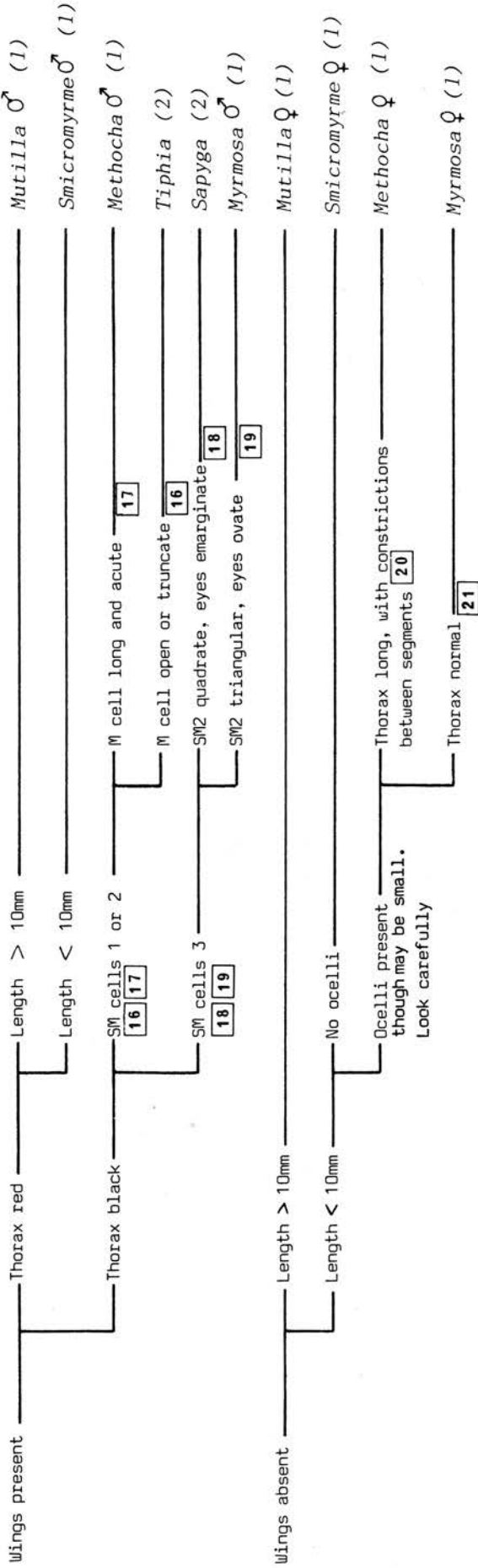
Pompiloidea The 'spider-hunting wasps', generally capturing spiders as larval food and dragging them back to individual nests rather than flying with them. Also to be found on flowers, often Umbellifers. Many occur in sandy places, but some are found in damp habitats and around tree stumps; a few parasitise other pompilids. Structurally rather uniform, so difficult to identify. All are black \pm 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, Vespid yellow. Mandibles short in Vespid, 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. Various 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).





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.

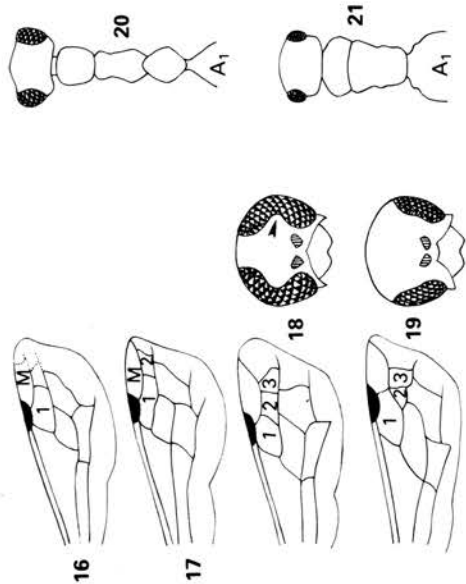
Myrmosa Male long black and shining, thorax punctate; tarsi long. Female black and red shining; thorax long, abdomen with short petiole. Tibial spurs 1, 2, 2. Male 6–12 mm, female 4–8 mm. Parasites of small sphecids.

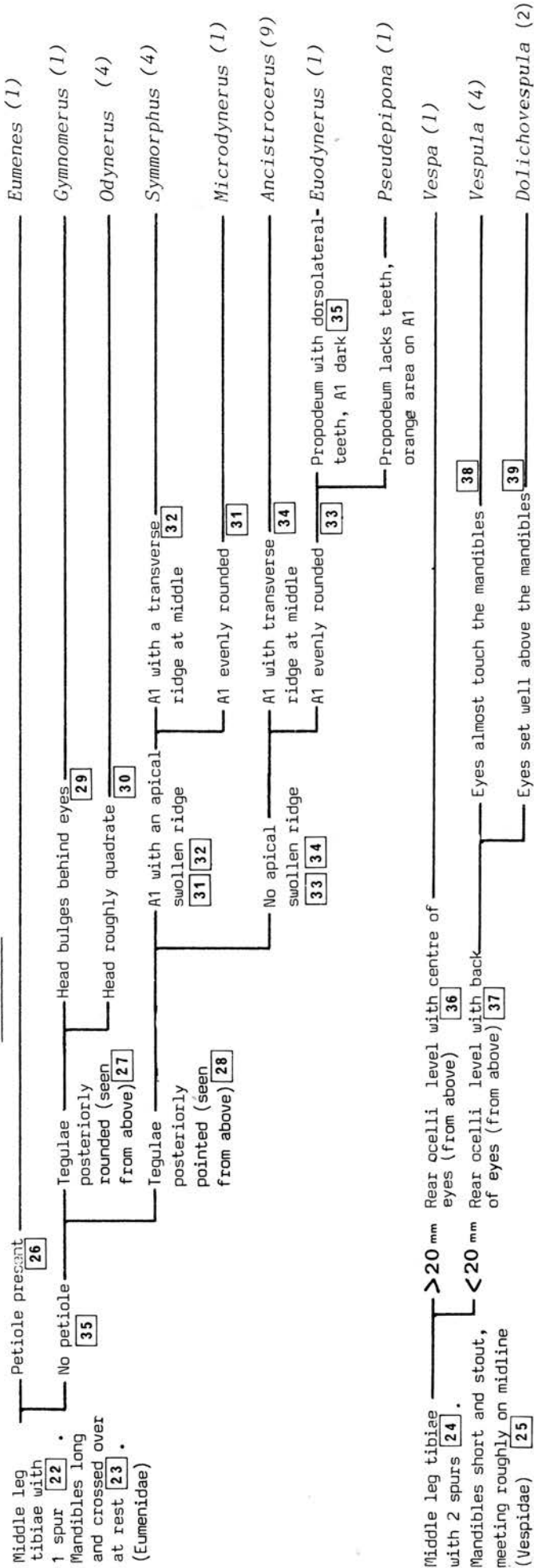
Tiphia Black, shining, with few white hairs; wings smoky, some red on legs, A1 narrow; pronotum long, propodeum heavily ridged. Legs spiny, with tibial spurs 1, 2, 2. 5–14 mm, locally common. Parasites of root-feeding scarabaeid beetles.

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 Hymenoptera's Handbook, but little recent work is available.





CONFIRMATORY CHARACTERS FOR THE GENERA OF VESPOIDEA

22 Middle leg tibiae with 1 spur and crossed over at rest. Mandibles long and crossed over at rest. (Eumenidae)

23 Middle leg tibiae with 2 spurs. Mandibles short and stout, meeting roughly on midline. (Vespidae)

24 Middle leg tibiae with 2 spurs. Mandibles short and stout, meeting roughly on midline. (Vespidae)

25 Middle leg tibiae with 2 spurs. Mandibles short and stout, meeting roughly on midline. (Vespidae)

26 Thorax showing A1 and A2 segments.

27 Tegula showing its shape and venation.

28 Tegula showing its shape and venation.

29 Rear ocelli level with center of eyes (from above).

30 Rear ocelli level with back of eyes (from above).

31 Thorax showing A1 and A2 segments.

32 Thorax showing A1 and A2 segments.

33 Thorax showing A1 and A2 segments.

34 Thorax showing A1 and A2 segments.

35 Thorax showing A1 and A2 segments.

36 Rear ocelli level with center of eyes (from above).

37 Rear ocelli level with back of eyes (from above).

38 Eyes almost touch the mandibles.

39 Eyes set well above the mandibles.

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

Gynommerus 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.

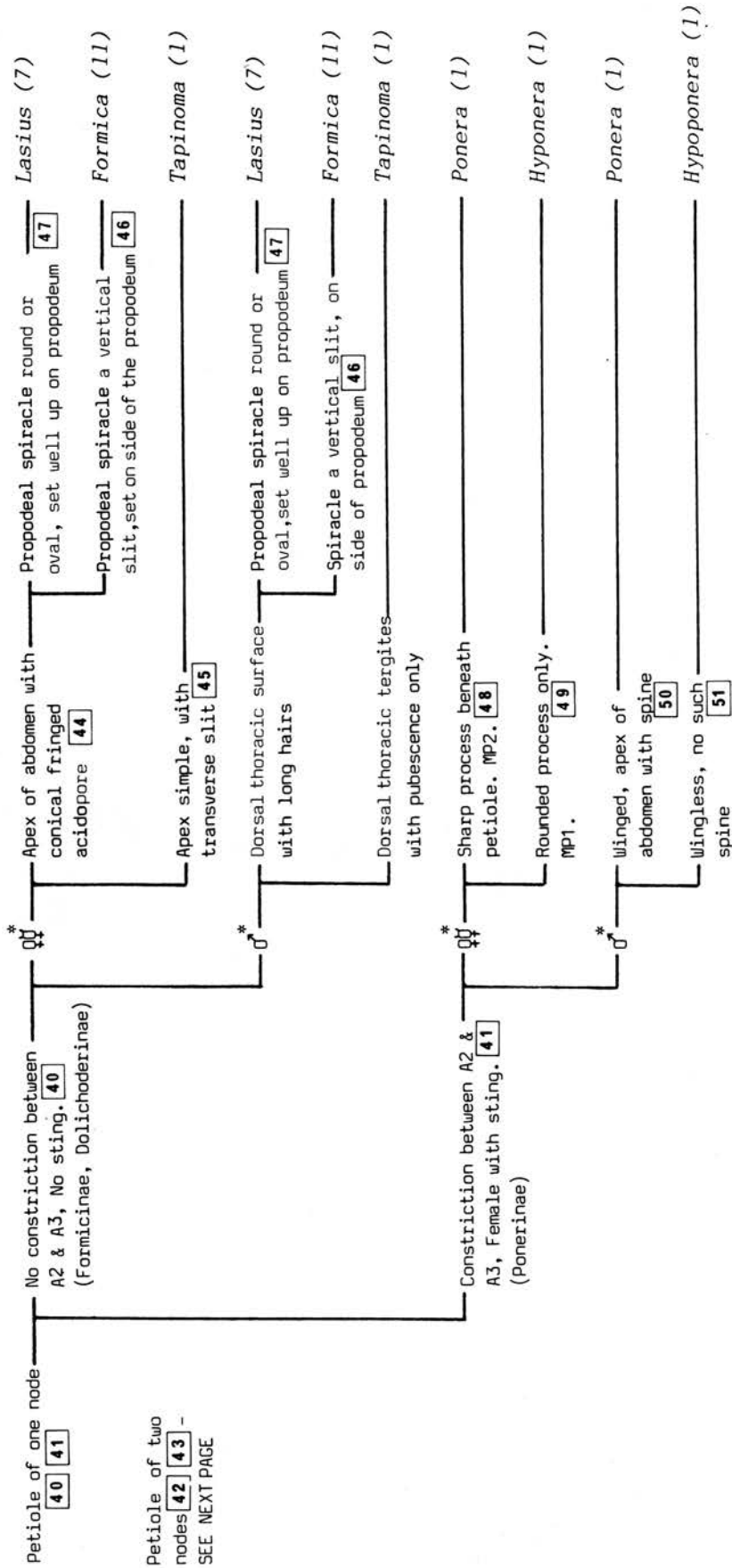
Vespula 9–20 mm. Clypeus hairy. Pronotum simple. Hard to distinguish from *Dolichovespula*.

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)

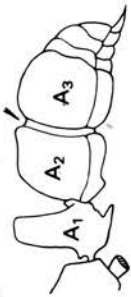


* SEX AND CASTE IN ANTS. ♀ - QUEEN ♂ - WORKER ♂ - MALE
 Note that winged forms will nearly always be males; wingless forms will nearly always be workers. Queens are rare, and will usually be larger; though winged initially, they then lose their wings but retain traces of wing-base attachments on the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

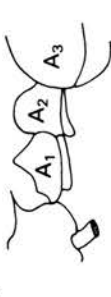
CONFIRMATORY CHARACTERS FOR THE GENERA OF FORMICOIDEA



40



42



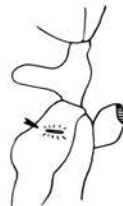
43



44



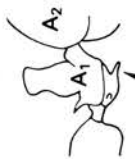
45



46



47



48



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50



51

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.

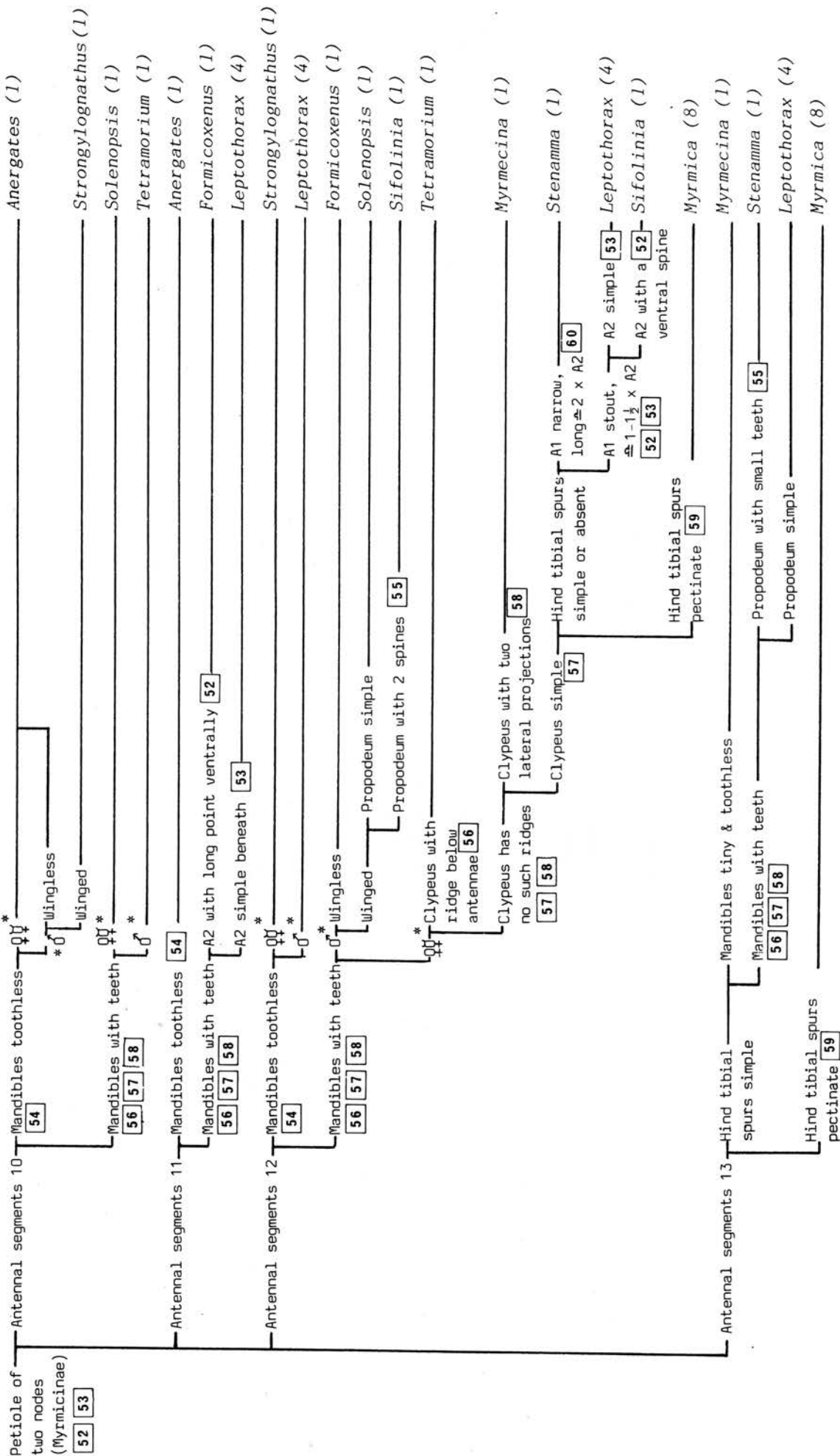
*The common genera *Lasius* and *Formica* are not easy for beginners to separate. However, *Lasius* workers are usually less than 4 mm long (but not always), and coloured yellow or orange, while *Formica* workers are usually more than 4 mm long and reddish or brownish. (The exception is *L. fuliginosus*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

Anergates No worker caste. Queen black-brown, extremities yellow, dull and punctate, MP2, LP1, sting reduced, eyes large, 2½ mm. Male dull yellow, wingless, abdomen bent under. Rare, usually found in nests of *Tetramorium*.

Strongylognathus Worker yellowish, mandibles long, top of head concave. 2½–4½ mm. Queen and male similar, slightly larger. Uncommon, usually in nests of *Tetramorium*.

Solenopsis Worker reddish-yellow, A3 darker, shiny, hairy, MP2, LP2. 1½–3 mm. Queen brown, extremities yellow, 6–6½. Male black, extremities yellowish, 4–5 mm. Locally common.

Tetramorium Worker black-brown, extremities yellowish, head and thorax longitudinally striate, MP4, LP3, 2½–4 mm. Queen brown, reddish extremities, 7–8 mm. Male as queen, 5½–6 mm, 3rd antennal segment elongate. Locally common.

Formicoxenus Worker reddish-yellow, shiny, ocelli often absent, MP4, LP3, 3½–4½ mm. Queen darker, 3½ mm. Male similar, 3 mm. Locally common, usually in nests of *Formica*.

Leptothorax Worker reddish-yellow. Extremities darker, MP5, LP3, 3½–4½ mm. Queen darker, 4–5 mm. Male black-brown, tibiae and tarsi yellow. 4½–5½ mm. A fairly common introduced ant, *Monomorium pharaonis*, 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. 3–3½ mm. Male brown, shiny, 3½ mm. Rare, usually in nests of *Myrmica*.

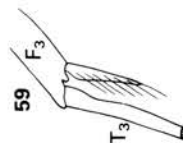
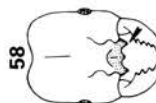
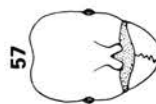
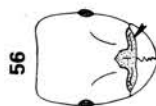
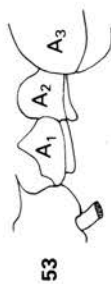
Myrmecina Worker black-brown. Hairy, extremities reddish, thorax longitudinally rugose, MP4, LP3, 3–3½ mm. Queen similar, wings darkened, 4–4½ mm. Male black, shiny and hairy, eyes and ocelli large. 3½–4 mm. Locally common.

Stenammas Worker reddish-yellow, lighter extremities, frons longitudinally rugose, MP4, LP3, 3½–4 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, 4–4½ mm. Queen similar, 5½–7 mm. Male black-brown, extremities lighter, 5–5½ 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).



POMPILOIDEA

KEY E

Ceropales (2)

Homonotus (1)

Aporus (1)

Episyron (1)

Anoplius (5)

Evagetes (3)

Pompilus (1)

Agenoideus (1)

Arachnospila (7)

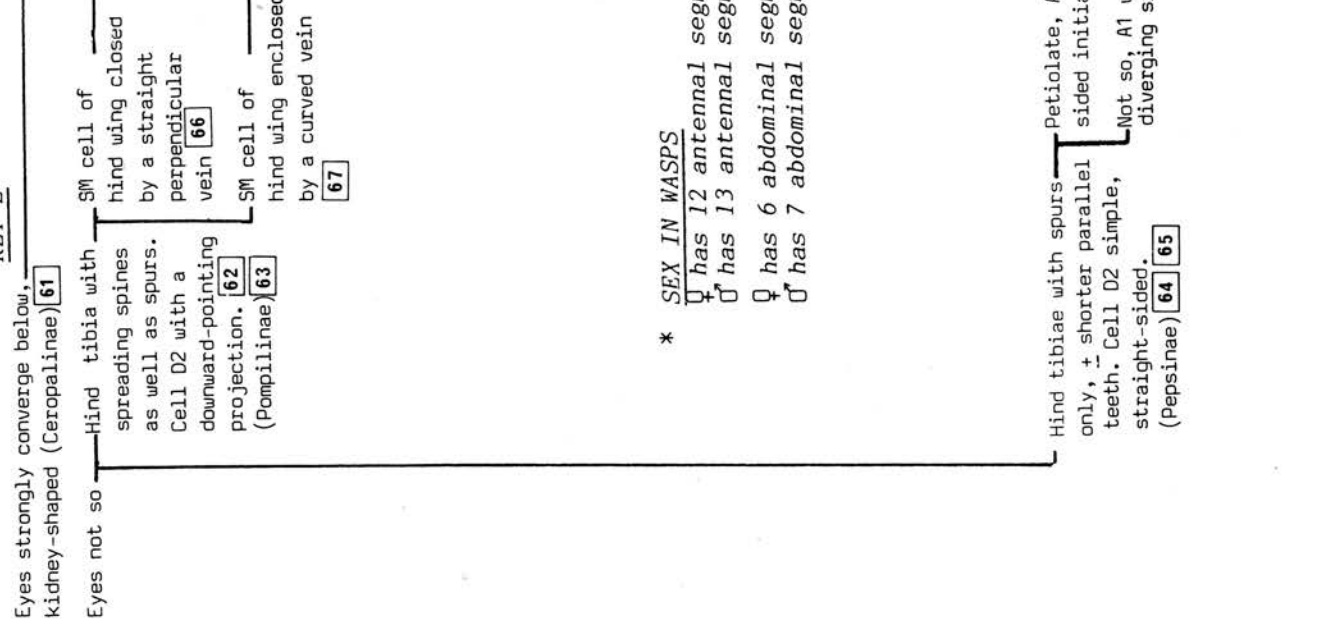
Auplopus (1)

Cryptocheilus (1)

Caliadurgus (1)

Priocnemis (13)

Dipogon (3)



* SEX IN WASPS

- ♂ has 12 antennal segments
- ♂ has 13 antennal segments
- ♀ has 6 abdominal segments visible
- ♂ has 7 abdominal segments visible

Hind tibiae with spurs only, + shorter parallel teeth. Cell D2 simple, straight-sided. (Pepsinae) [64] [65]

Petiolate, A1 parallel-sided initially [78]

Not so, A1 with gradually diverging sides [79]

♀ hind tibia serrated below [80]

♂ antennal segments simple [83]

♀ hind tibia smooth [81]

♂ antennal segments dilated below [82]

M cell blunt at tip [84]

M cell acute at tip [85]

Propodeum dull, stigma narrow [65]

Frons raised at middle. Post-notum broad and shining; not hidden by metanotum from above [73] [75]

Stigma wide with curved outer margin. Black, red legs

Stigma short, narrow, straight-edged. Black, with A1 - A3 red

Propodeum with blue sheen, stigma fairly broad [85]

Propodeum dull, stigma narrow [65]

Black, grey pubescence all over

Stigma wide with curved outer margin. Black, red legs

Stigma short, narrow, straight-edged. Black, with A1 - A3 red

Propodeum with blue sheen, stigma fairly broad [85]

Propodeum dull, stigma narrow [65]

CONFIRMATORY CHARACTERS FOR THE GENERA OF POMPILOIDEA

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

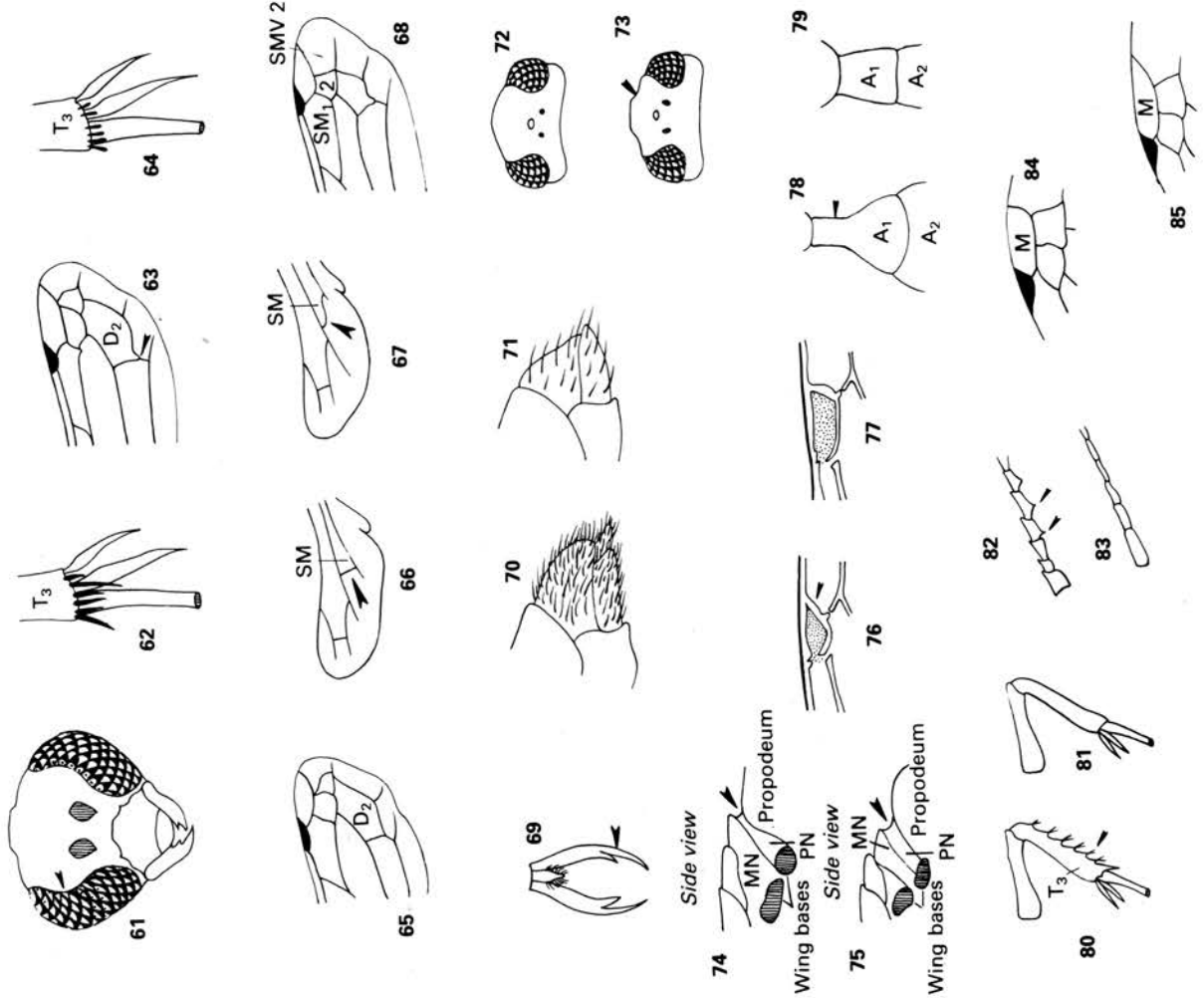
Anoplius 5–15 mm. Black, ±A1-n red. Dark anal bristles in female.
Evagetes 5–13 mm. Black ±A1-n red. Only 2 SM cells in 1 of the 3 spp.

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

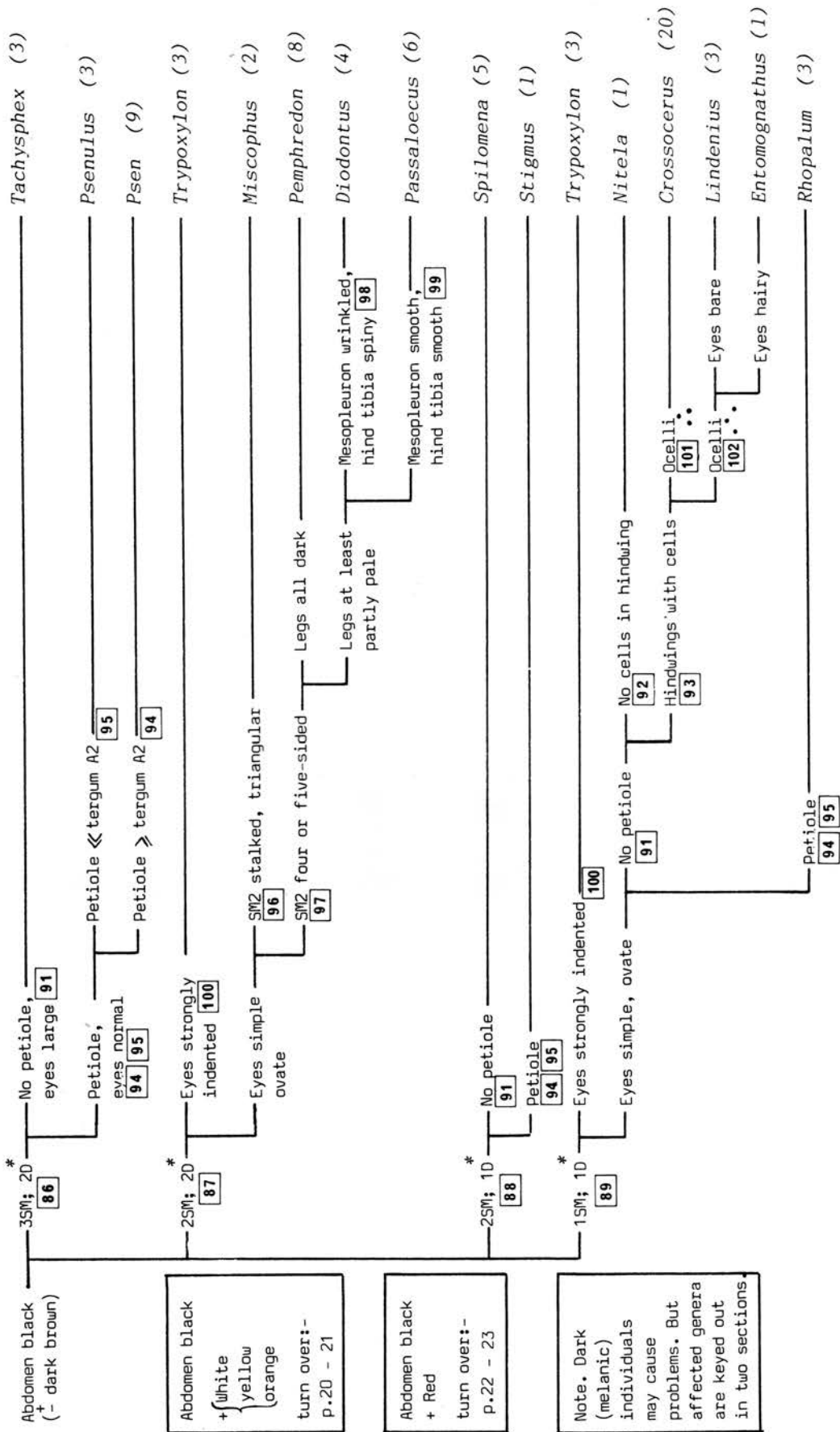
FURTHER READING AND IDENTIFICATION

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)



Abdomen black
+ {white
yellow
orange}
turn over:-
p.20 - 21

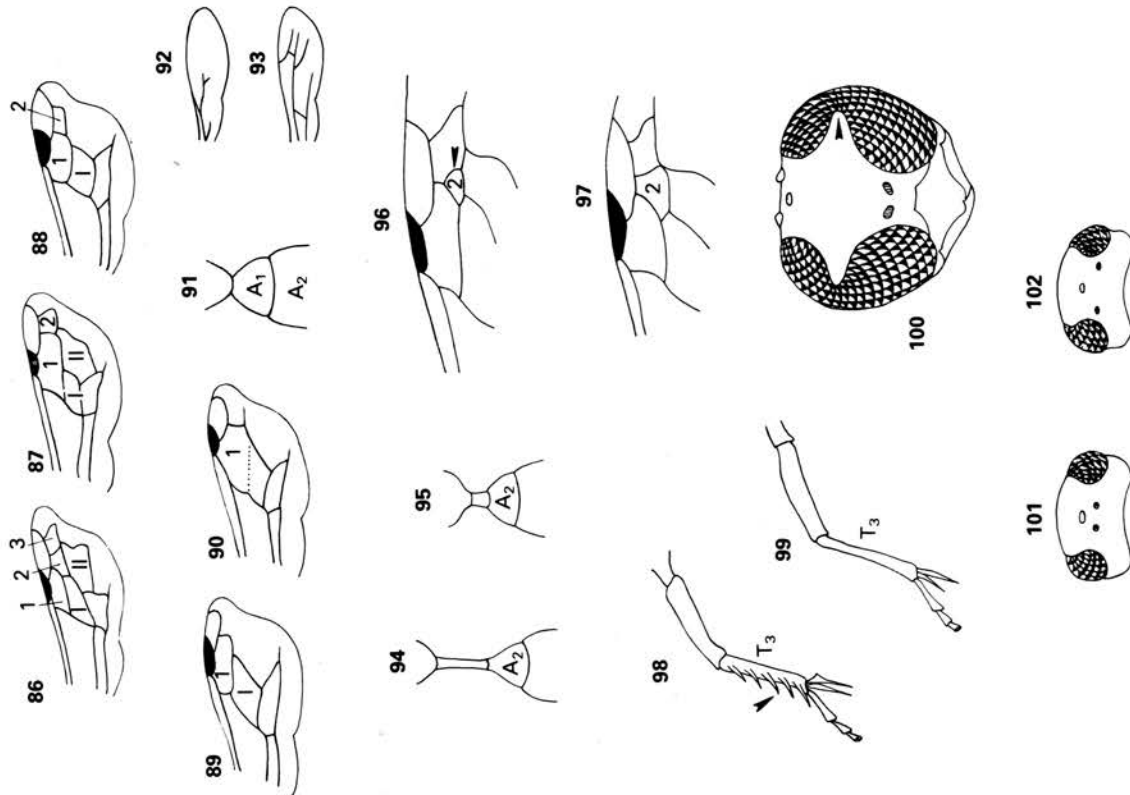
Abdomen black
+ Red
turn over:-
p.22 - 23

Note. Dark
(melanic)
individuals
may cause
problems. But
affected genera
are keyed out
in two sections.

* 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.
- Passaloeus* 3–7 mm. Abdomen quite slender, head short. Very short petiole.
- Stigmus* 3½–6 mm. Stigma large. Mandibles yellow, antennae pale. Uncommon.
- Spilomena* 2½–3 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* 2½–5 mm. Eyes converging above. Sub-discoidal cell of forewing open. Rare.

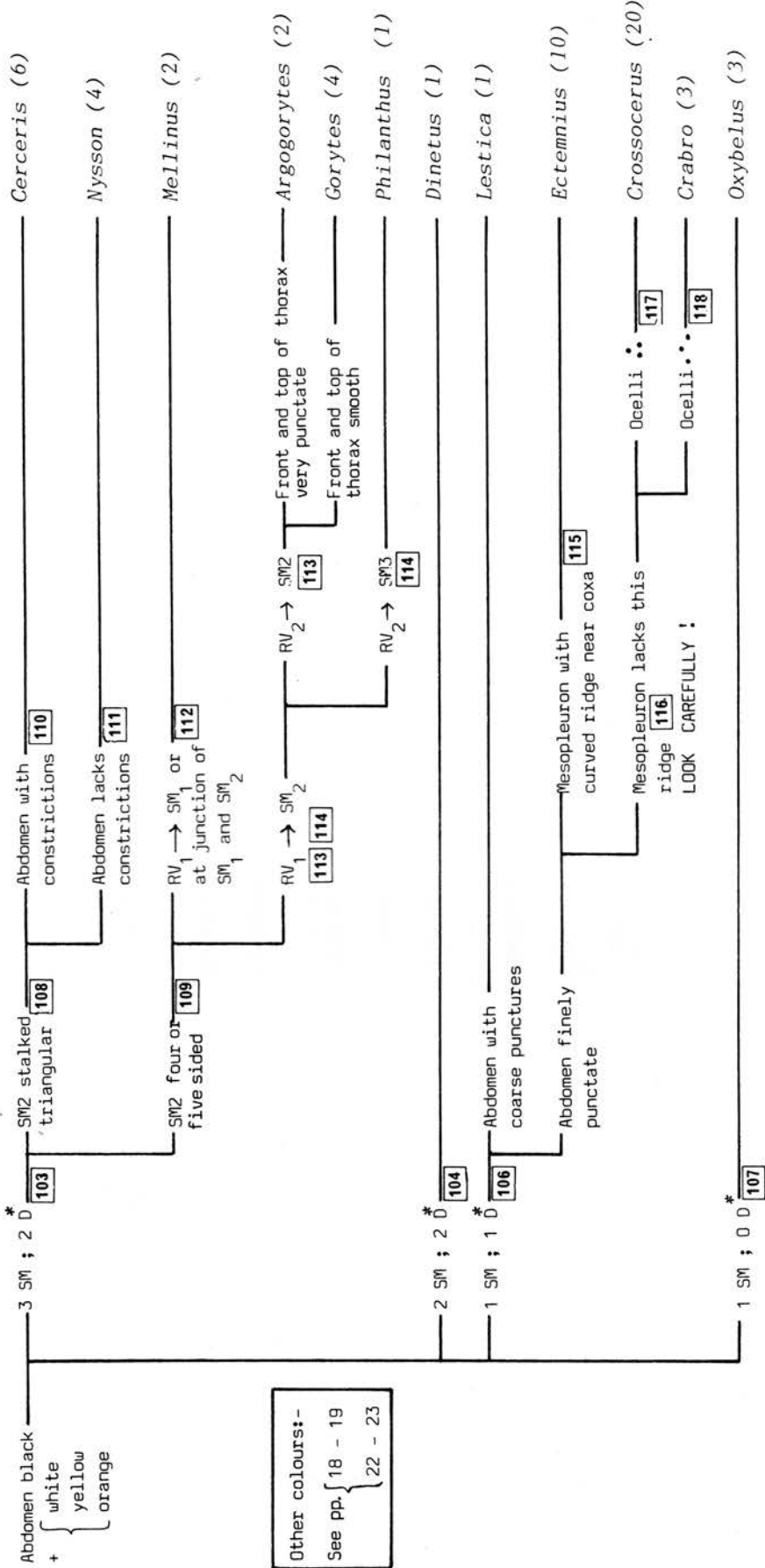


FURTHER READING AND IDENTIFICATION

See last key in this section.

KEY F

SPHECOIDEA (continued on next page)

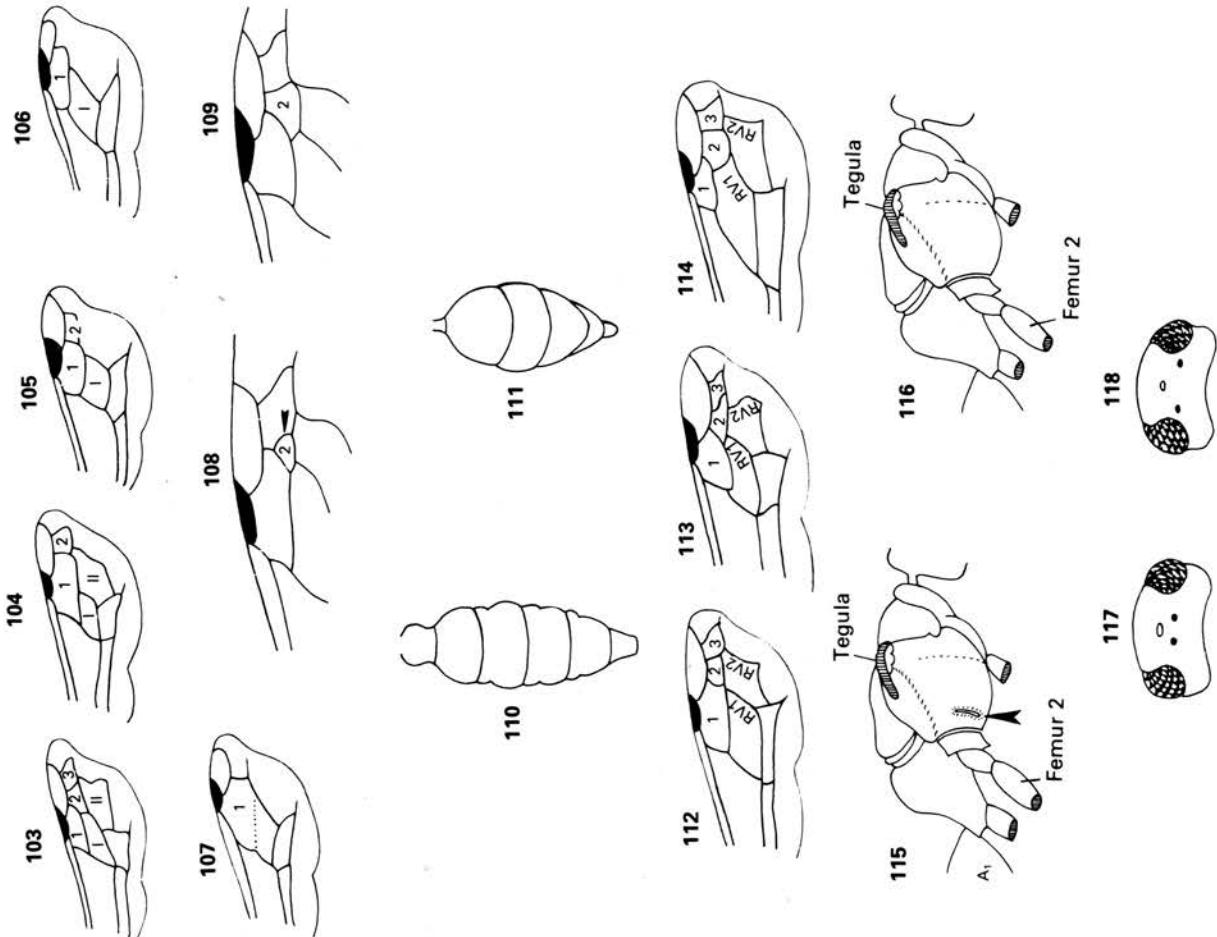


* IMPORTANT. Wing venation can be variable between left and right wings. CHECK BOTH WINGS.

CONFIRMATORY CHARACTERS FOR THE GENERA OF SPHECOIDEA

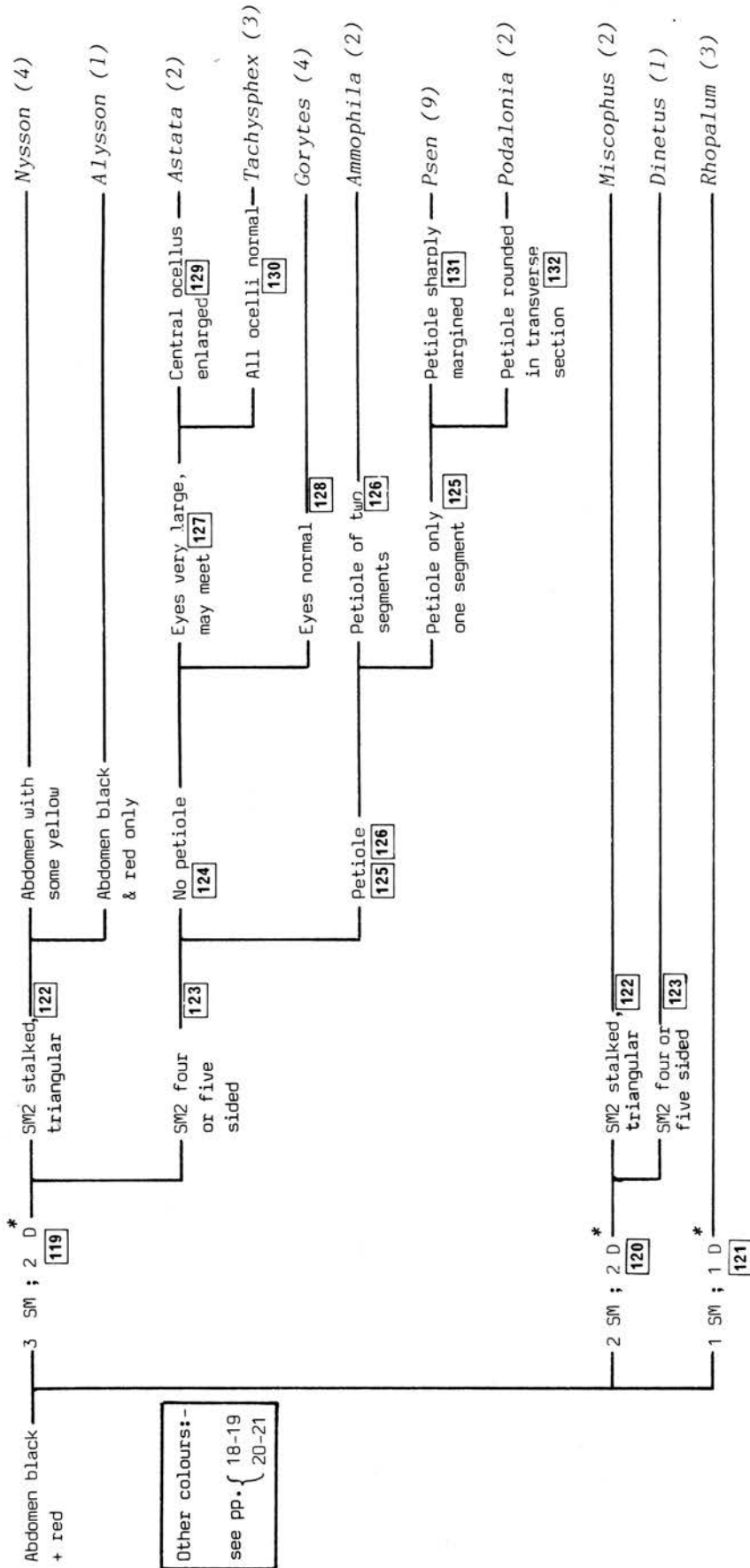
- Cerceris** 8–16 mm. Head large, eyes diverge ventrally. Antennae set high, frons keeled, face with yellow pattern. No petiole.
- Philanthus** 10–15 mm. Head and thorax large. Eyes diverge ventrally. Face with white or yellow marks. No petiole. Locally common.
- Argogorytes** 9–14 mm. Propodeum short. 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.
- Lesticia** 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.



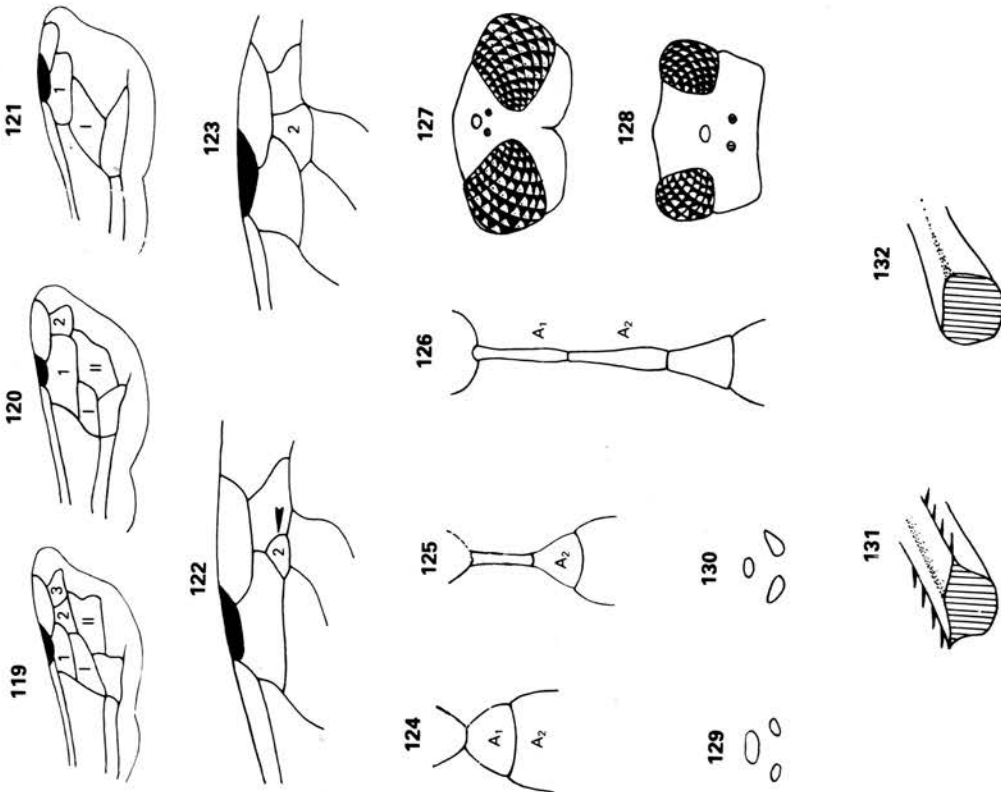
KEY F

SPHECOIDEA (continued from previous pages)



Other colours:-
see pp. { 18-19
20-21

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



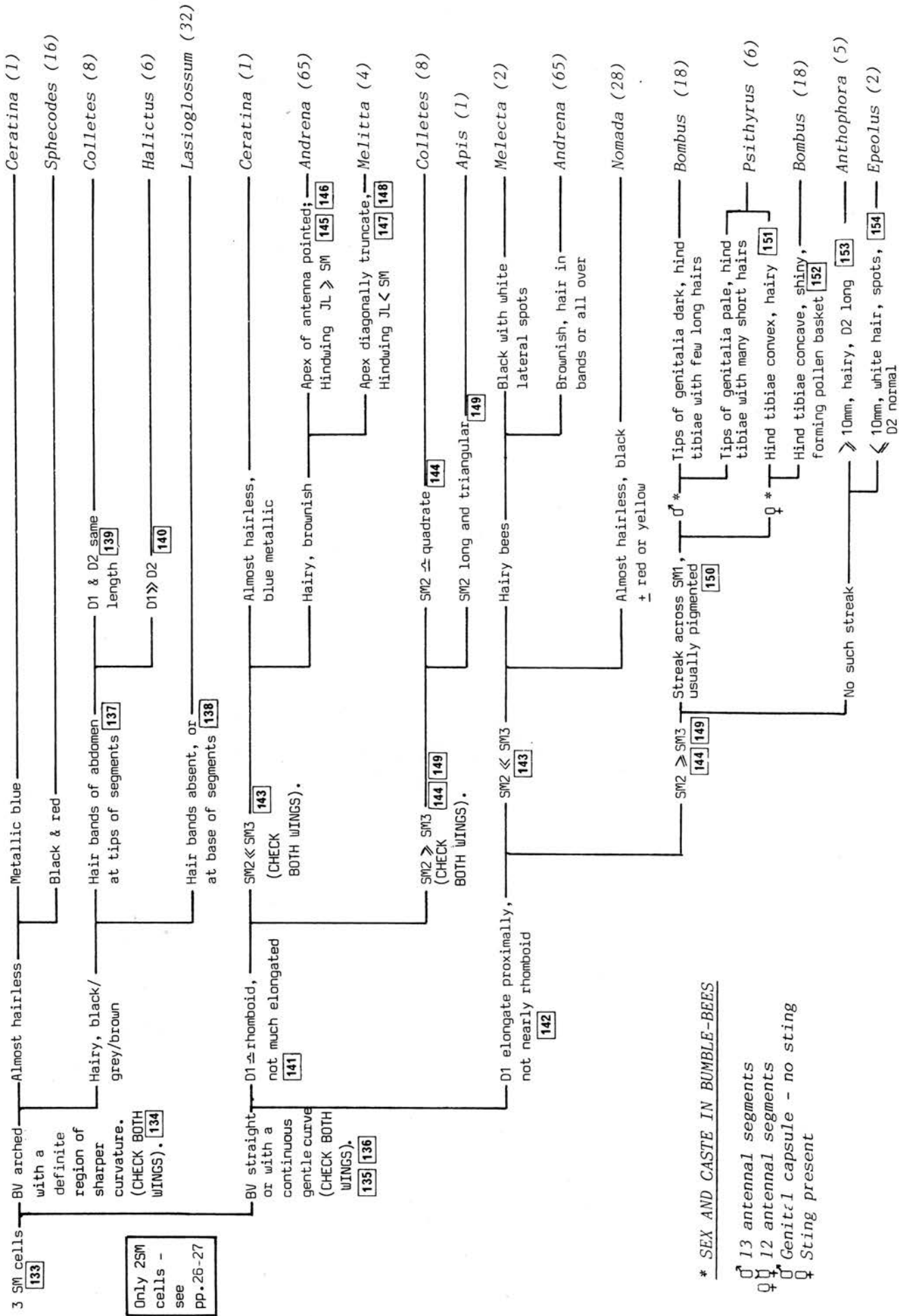
CONFIRMATORY CHARACTERS FOR THE GENERA OF SPHECOIDEA

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)



Only 2SM cells - see pp. 26-27

* SEX AND CASTE IN BUMBLE-BEES

♂ 13 antennal segments
 ♀ 12 antennal segments
 ♂ Genitrl 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.

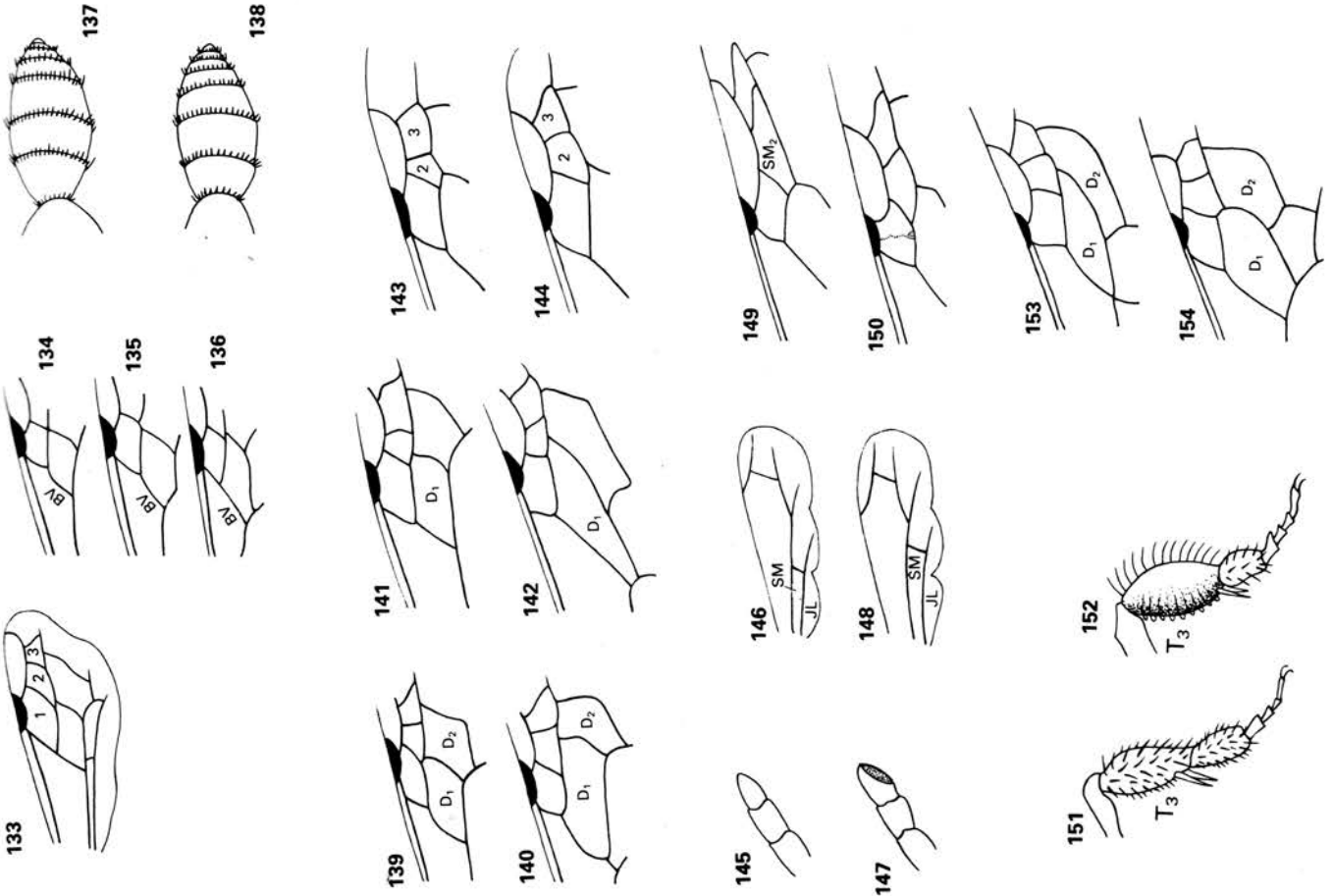
Note that colours given here usually refer to the cuticle and this ground colour may be obscured by a covering of dense pale-coloured hairs.

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.

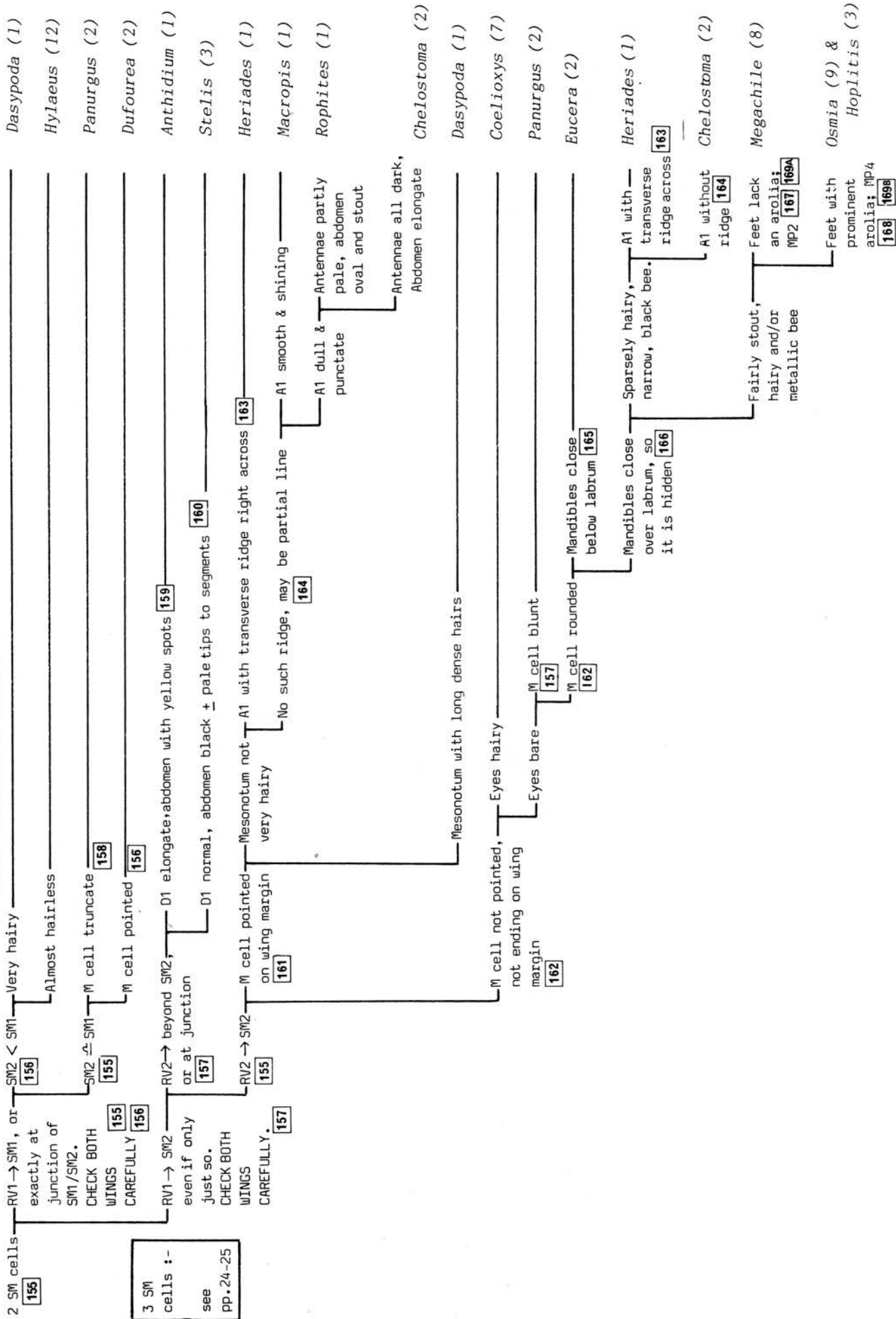
FURTHER READING AND IDENTIFICATION

See notes on next page.



KEY G

APOIDEA (continued from previous page)



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.

Dasydopa 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*, *Lasiglossum* & *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.

