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A Guide to the Ants of South-western Australia

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PREFACE

Increasingly, invertebrates are being used as indicators of environmental health in various native and altered ecosystems throughout Australia. Among invertebrates that can be utilised in this way, ants are a very suitable indicator group because they are abundant and have high biodiversity, are relatively well known taxonomically, are easy to collect and identify, and are sufficiently robust to be able to be handled without special preparation. They are also reasonably sensitive to environmental disturbance.

Assessing the progress of revegetation of minesites is one of the more common applications where ants can be used as indicators of success. However, to this point of time, there has been no single authoritative reference source for the ant species found in Western Australia, including those collected in rehabilitated minesites and other programmes involving sampling of ants. This present work attempts a comprehensive overview of all the described ant species currently recognised from the south-west of Western Australia, specifically, the South-West Botanical Province (a phytogeographic zone). Also included are the many undescribed species, or those of uncertain taxonomic status, recognised by the Curtin University of Technology. The latter are indicated in this monograph by voucher numbers. Taxonomic keys will enable an enquirer to arrive at subfamily, genus and species name (if described) for any particular worker ant specimen.

Although this volume covers the ants of South-Western Australia, many of these species are also present in the Pilbara, where Rio Tinto Iron Ore has most of its mining interests. We are therefore proud to be associated with the sponsorship of this important work.

Warwick Smith
Managing Director Expansion Projects
Rio Tinto Iron Ore

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A Guide to the Ants of South-western Australia

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Abstract – This work constitutes a review of what is known about the ants of the South-West Botanical Province, a region internationally recognized as having a megadiverse flora. The ant fauna is also highly diverse, including no fewer than 12 subfamilies, 61 genera and at least 500 species. The author includes three illustrated taxonomic keys to the 13 Australian subfamilies, 61 genera and the workers of 497 morphospecies, respectively. The last-mentioned key includes all species described for the region, but excludes a tiny handful that cannot be identified with assurance because the information in the original description is too scant or the type specimens have been lost. Also included in the species key are workers of all the other morphospecies known from the Province that appear to constitute recognizable species, and are at present allocated voucher numbers in the Curtin Ant Collection. Many of the south-west ants (almost 50%) appear to be undescribed. All of the above ant taxa, described or undescribed, are included in a discussion following the keys. Novelties mentioned in the key to genus include the first WA record of the genus Mayriella, and the genus Rogeria (tentatively assigned to two species). The genus Anillomyrma is removed from the WA checklist, as the local species is now considered a Monomorium. Four species (Iridomyrmex argutus Shattuck (under Iridomyrmex innocens Forel), Iridomyrmex occiduus Shattuck (under I. innocens Forel), Pachycondyla (Trachymesopus) clarki Wheeler (under Pachycondyla (Trachymesopus) rufonigra Clark), and Crematogaster perthensis Crawley (under Crematogaster frivola (Forel)) here pass into synonymy, and Tapinoma rottnestense Wheeler becomes Doleromyrma rottnestensis (Wheeler) in a new combination. Also included in this work are short discussions on a variety of topics not well covered in the Australian ant literature, a comprehensive glossary of terms, a complete ant check list (Appendix 1) and a table showing known ant species distributions within the seven botanical districts that together make up the South-West Botanical Province (Appendix 2).

Key words: South-West Botanical Province, ant fauna, taxonomic keys

INTRODUCTION

The phytogeographic region in Western Australia known as the South-West Botanical Province, (hereafter, SWBP) (Figure 1), is well known as a hotspot of mega-diversity for vascular plants (e.g. Beard *et al*. 2000). However, this region also has a rich ant fauna, with, for example, approximately ten times the number of ant species found in the United Kingdom. Twelve of the thirteen subfamilies currently recognized as occurring in Australia can be found in the SWBP. The thirteenth subfamily, Aenictinae, has been recorded south-east of Newman (Pilbara region) and may well occur in the far north of the SWBP. For this reason, the key to subfamilies provided below includes the Aenictinae.

At a generic and species level, the ant fauna is also very diverse: the actual number of species possibly exceeds well over 500. At the present time, to the author's knowledge, sixty-one described ant genera, including almost 500 identifiable morphospecies, have been recorded for this Province. These are the species that appear in the key to worker ants for the Province. Over half-a-dozen additional names for ants described from the region can be found in the literature, but their status is uncertain and the bulk of these are likely to become junior synonyms in future revisions. The paucity of novel taxa now being identified by Curtin staff and students, along with myself, suggests that additional species to those covered in this monograph are likely either to be very rare, or at the fringes of a distribution that mostly lies outside of the SWBP.

Despite the high ant biodiversity at a species level, only six of the twelve subfamilies are represented by two or more genera. On the generic level, several important recent changes from the genera discussed in Shattuck (1999) are noted here:

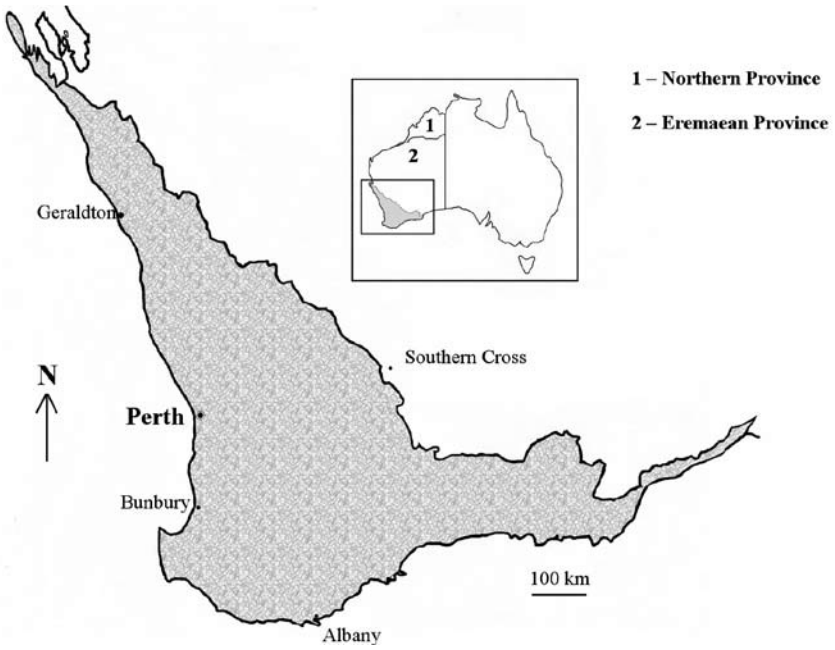

Figure 1 The South-West Botanical Province, showing major cities in the Province. Inset: The South-West Botanical Province in relation to the rest of the Australian land mass. (Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) Version 5.1; modified in the NE portion following Gunawardene and Majer, 2004).

Oligomyrmex (one species) now becomes *Carebara*, following Fernandez's (2004) revision of the group; the monotypic genus *Nebothriomyrmex* has been erected for a tiny dolichoderine known only from the SWBP (Dubovikov 2004); *Bothriomyrmex* is now *Arnoldius* (Dubovikov 2004); and Shattuck's (1999) myrmicine genus indet. no. 2 (with two species occurring in the SWBP) is here tentatively identified as *Rogeria*, based on Bolton (2003). This latter genus, which is widely distributed in the Neotropical and Indo-Australian region, has not previously been recognized from the Australian continent. Incidentally, Shattuck's myrmicine genus indet. no. 1 (Shattuck 1999) is identified in this Guide as a *Monomorium*, i.e. *Monomorium elegantulum* Heterick.

In addition, this work records and discusses genera not previously recorded for the Province in the existing literature. *Mayriella*, a genus formerly believed to be restricted to the eastern half of Australia, was recently discovered in a DEC (Department of Environment and Conservation) survey of the Nuyts Wilderness area near Walpole, on the south coast, and the latest addition to the list, a species of *Ponera*, has been found in a pitfall trap sample taken from an Alcoa mine site near Jarrahdale. Of the previously recognized genera, *Nothomyrmecia*, described many years ago from workers taken from somewhere near the Russell Range (in the far south-east of the SWBP), has not been seen in WA for many years, and may be extinct in this State. Moreover, as far as is known, the myrmicine genus *Anillomyrma* is not present in Australia, and the small blind ants formerly placed in this genus are more properly assigned to *Monomorium*. One undescribed species occurs in the south-west.

BOTANICAL DISTRICTS WITHIN THE SWBP IN RELATION TO THE ANT FAUNA

Seven botanical districts, identified by their own distinctive phytogeographic features, can be found within the SWBP. These are the Avon Wheatbelt (AW), characterised by open eucalypt woodland with areas of scrub-heath, the Esperance Plains (ESP), which is mainly mallee-heathland, the Geraldton Sandplains (GS), predominantly scrub-heath with some taller trees, the Jarrah forest (JF), which originally was mainly medium-height eucalypt forest but has now been much modified by farming and urban development, the Mallee (MAL), consisting of eucalypt shrubland, patches of scrub-heath and a mosaic of woodland and mallee in the north-east, the Swan Coastal Plain (SWA), originally a mix of jarrah woodland, banksia low woodland, teatree swamps and thicket (*Acacia*, *Allocasuarina* and *Melaleuca*), but which, like the Jarrah forest, has now been much modified by urban development, and, finally, the Warren (WAR), a distinctive wet sclerophyll region of tall forest, including some of the largest trees in WA.

To some degree, the diversity of the ant fauna of a region reflects the floristic communities in which it lives, but probably soils are a more important factor

governing nest establishment for a given species in the SWBP (here, it should be noted that WA has very few truly arboreal ants, or species that are specialist nesters, e.g. in rotten logs or twigs). While a number of species from the most abundant genera, e.g. *Iridomyrmex*, *Monomorium* and *Rhytidoponera*, can be found anywhere in the SWBP, other species, including those from genera with more specialized behaviours, tend to be localised. Hence, some ants may be found only on sand-plain, whether this sand-plain be in the form of coastal dune systems, or sand dunes many kilometres inland. Others appear to be restricted to laterite soils. Within a single locality, nests of some species are found only on the swales whilst others are located only on the dune crests. Cryptic species may not be restricted to a particular floristic community, but may be absent from any area that lacks the requisite litter layer in which they prefer to live. Conversely, many species of *Melophorus* and some *Iridomyrmex* require open ground and highly insolated sandy soils for their nests.

The very small number of ant species that appear to have an entire global distribution limited to a few square kilometres are almost completely unstudied, and the reasons for their restricted distribution are unknown. These taxa include several species of *Myrmecia* and *Monomorium*, *Carebara* sp. JDM 440 and *Notoncus* sp. JDM 487. The bulldog ants, from the subfamily Myrmeciinae, probably include the bulk of the genuinely rare and potentially threatened species. The isolated occurrence of these species, their small colony size, and their vulnerability to disturbance make them candidates for special protection under future legislation. In the case of other ants that are very restricted in WA but much more abundant on Australia's east coast, climate and environment are clearly factors affecting their distribution. *Myopias tasmaniensis* Wheeler is one such species. Their distribution often follows a typical Gondwanan pattern, i.e. they are found in cool, wet habitats in thick forest.

A list of all ant species (including morphospecies) known by myself to be recorded from the SWBP is given in Appendix 1, while their known distributions are listed in Appendix 2. The latter is intended as a guide only, as it reflects an inevitable bias towards those districts that are closest to research institutions (especially in Perth), and hence more accessible to researchers. Nonetheless, several areas have been found to be particularly ant rich. These include the eastern flanks of the Darling Range, embracing the eastern JF District and western AW District, and kwongan heath in the GS district, north of Perth. At mineral sand minesites near Eneabba, in the heart of the GS, upwards of 115 species have been collected within a few hectares. The ESP and MAL Districts have been relatively little collected, and their fauna counts are likely to rise steeply as more attention is directed towards collecting in those districts. Conversely, the count for the WAR District is unlikely to rise substantially, since the relatively cool and moist climate and the thick closed forest are not conducive to a high ant biodiversity. Those species recorded from this District are typically cool climate specialists and cryptic species, many of which are rare taxa, found in small nests under stones and logs. Species distributions in Appendix 2 are based primarily on type locality data, Curtin holdings and information from published sources, especially recent monographs. Additional species are likely to be held in other institutions, as well as specimens collected from outside of their distribution as listed in this work.

NOMENCLATURE

Subspecies categories in ant research are a relic of earlier nomenclature and modern revisions invariably eliminate these, either by erecting the subspecies to full species status or by relegating them to synonymy. As this work is not meant to be a formal revision, I have refrained from synonymising taxa, except (after the urging of a colleague) for a small handful of cases in which I have looked carefully at the relevant type specimens. These alterations are indicated in bold font and by the use of round brackets in Appendix 1. A number of other species appear to me likely candidates for synonymy, and I have drawn attention to those taxa when discussing them in the text and by enclosing them in square brackets in Appendix 1.

Where possible, ant species in this work are primarily designated by their scientific name. Genuine common names barely exist and would be meaningless in view of the number of ants involved, though an effort by Andersen (2002) to supply names of his own devising for very many mainly northern and desert-dwelling species should be mentioned here. In a few cases I have indicated common names for genera where these appear to be in widespread use, both in Australia and overseas. Where the scientific name is unknown or the ant is undescribed, a Curtin Ant Collection (JDM) voucher number has been used. In a small number of cases a voucher number assigned by the Australian National Insect Collection (ANIC) in Canberra exists, and this is preferred to the former voucher number because of its greater currency.

WHAT'S IN A NAME?

The concept of 'species' is not the simple matter supposed by the person-in-the-street. As indicated

above, I personally consider that there are around 500 ant species in the SWBP, but are they all what is known in scientific circles as 'good species'? Indeed, what is a 'species'? The question is far from simple, and has implications for conservation and pest management, to name just two important areas.

For some people, individual species are simply those living entities that can be recognised by their unique appearance. Yet populations of apparently identical organisms can have quite different behaviours. Others will point to the fact that animals mate with their own kind – but, just like their domestic counterparts, wild animals can produce hybrids in some situations. A slightly more sophisticated approach is to determine which animals share a similar DNA profile. However, even DNA or RNA analysis does not necessarily provide a definitive answer as to whether two organisms are different. In some cases 'good species' show very slight differences in DNA profile while others show considerable variation. In fact, in very few cases are all individuals of a species identical, either morphologically or genetically, with most species showing weak to strong geographic variation.

While these considerations form part of the answer to the question 'what is a species?', they do not provide the whole answer. The question can be approached from a number of different directions, and the interested reader is referred to recent works by Ereshefsky (1989), Howard and Berlocher (1998), and Coyne and Orr (2004). Harrison (chapter 2 in Howard and Berlocher 1998) places the more popular species concepts under seven headings. In the interests of economy, just five of the seven species concepts will be discussed briefly here.

Until recently, the 'biological species' concept has predominated in scientific circles (heading 1 in Harrison's listing). Mayr (1942, 1963, 1982) popularised the concept, and his 1963 work is the most widely cited. He defined species as 'Groups of actually or potentially interbreeding natural populations which are reproductively isolated from other, such groups' (Mayr 1963, p. 19). Mechanisms that maintain a separation between species (defined as 'isolating mechanisms' by Mayr) include disparate morphology (particularly of the reproductive parts), and various behavioural and geographic factors. A superficially similar but subtly different concept is that of Paterson (1978, 1981, 1982, 1984, 1985, 1988 , 1993) called the 'Specific Mate Recognition System' or SMRS (heading 2 in Harrison's list). Paterson's theory states that a species is a 'most inclusive population' of male and female organisms that shares a common fertilisation system. To ensure successful procreation, all sexual organisms have co-evolved structures or behaviours that ensure either of the two sexes mate only with their own kind.

Another species theory dealing with biological process is the 'Cohesion Species Concept' (Harrison's heading no. 3). This states that a species is 'The most inclusive population of individuals having the potential for phenotypic cohesion through intrinsic cohesion mechanisms' (Templeton 1989, p. 12). By 'cohesion' is meant those mechanisms that direct organisms to mate with their own species rather than another species. While both Mayr and Paterson emphasise genetic cohesion, additional factors such as host plant associations, life cycle, courtship display or even occupation of the same ecological niche need to be considered in the above theory.

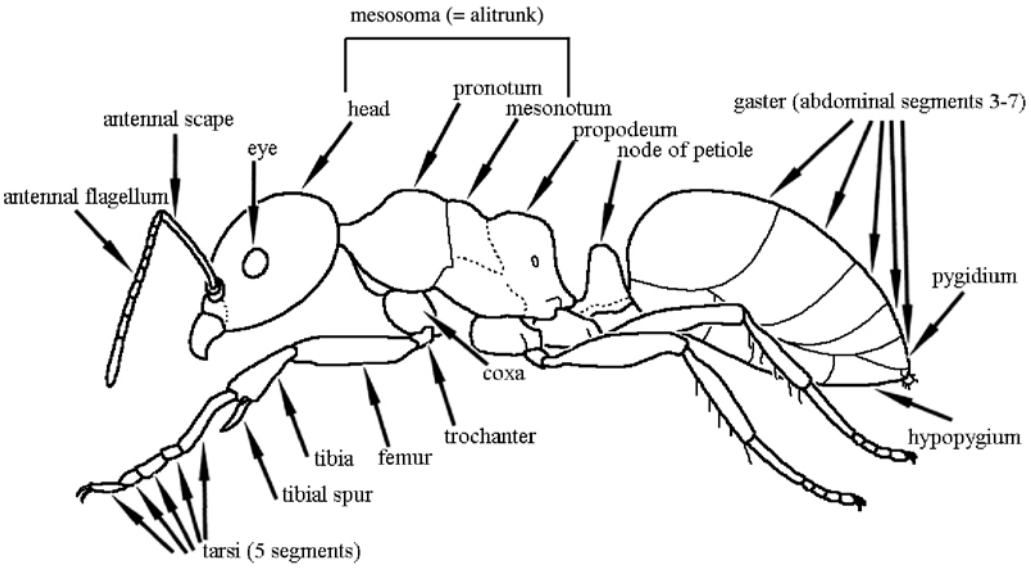

Figure 2 External anatomy of a theoretical worker ant (one-segmented waist).

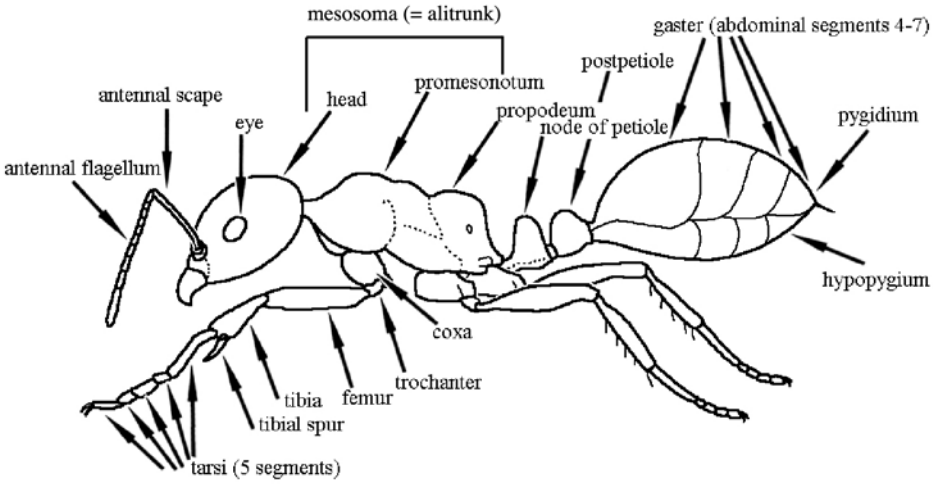

Figure 3 External anatomy of a theoretical worker ant (two-segmented waist). (n.b. Some subfamilies with a two-segmented waist do not have a fused pronotum and mesonotum.)

Whatever their merits, one pressing practical issue with theories based on the biology of the organism is that the collector or ecologist is often not in a position to test a particular theory. Invertebrates pose an especial problem because they are highly diverse, usually very small and even general aspects of their biology are often not known. Invertebrates, moreover, are mostly collected as dead specimens in traps, and dead animals do not mate.

In recent years, an alternative set of concepts has arisen that adopts quite a different approach and does not necessarily require knowledge of the behaviour of live organisms. These concepts focus less on the speciation process and more on the nature of individual characters possessed by an organism. Character states can be electronically sorted to produce diagrams ('tree diagrams') that are interpreted using hennigian cladistic analysis. A typical and popular theory is that of Cracraft (1983), who states that a species is the smallest

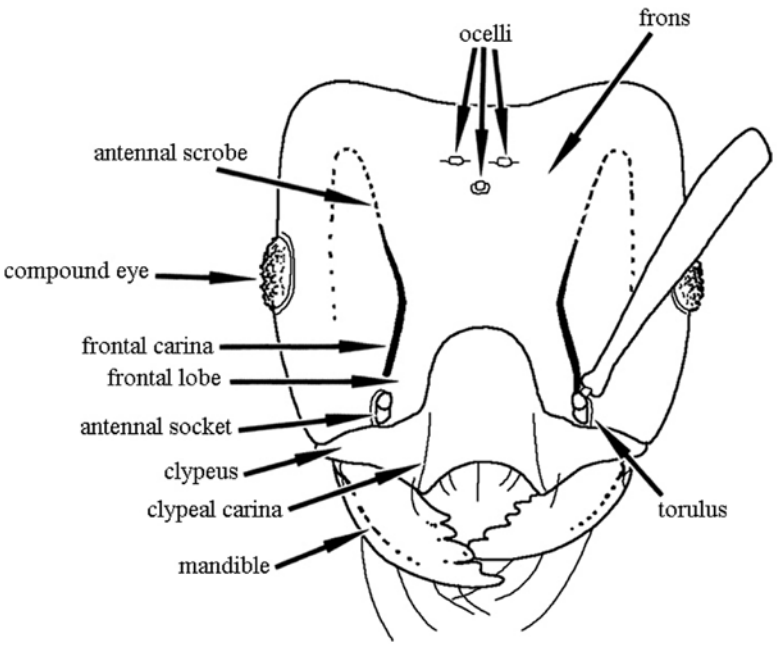

Figure 4 Full-face view of head of ant showing features mentioned in this text. This is a composite drawing: many species lack one or more of the structures illustrated above.

diagnosable cluster of individual organisms within which there is a parental pattern. To arrive at a species, a researcher needs to identify (1) any heritable diagnostic character or series of characters and (2) reproductive cohesion. Davis and Nixon (1992) apply a version of this theory to practical examples. This approach constitutes heading no 4 in Harrison's analysis, the 'Phylogenetic Species Concept'. Other modifications of this approach are found in Mischler and Brandon (1987) and Mallet (1995). Mallet looks more particularly at genes. The latter's approach constitutes 'The Genotypic Species Cluster Definition', Harrison's heading no 7. With Mallet, the concept of 'species' is reduced to genotypic clusters. If the latter's theory is applied, say, to non-recombinant DNA molecules (as in those from mitochondria), additional assumptions are needed. Yet another potential problem, in this case with interpreting the output of RNA analysis, occurs if tree reconstruction artefacts (caused by fast evolving gene sequences) go unrecognised (e.g. Philippe *et al*. 2005).

The chief difficulty with the character-based theories is quite different to that encountered with biologically-based concepts. With the latter, the process, though logical and coherent, cannot be easily identified, whereas the process in the former is unknown, vague or treated as irrelevant in favour of diagnosable characters. Other complications include inappropriate algorithms used to construct the cladograms or other tree diagrams; i.e. the particular algorithm being used can bias the output. Harrison, himself, proposes a synthesis, in which various species definitions are appropriate to a population of organisms as it evolves over time.

In the context of this monograph, the question of 'species' is important, but as I have just indicated, it is a difficult concept to pin down. Where does that leave the person who simply wants to identify an ant? Fortunately, most taxa are so distinctly and unvaryingly morphologically different from other taxa that sufficient genetic distance can be assumed for them to be treated as separable reproductive units – i.e. 'species' - under any theoretical construct. This certainty is enhanced where the male and female reproductive castes (in the case of ants) are well known, and are equally distinguishable. Other ant taxa may not be so easily separated, but consistent differences do exist and can be recognised by experienced workers, and molecular work confirms substantial genetic differences. What is left is a usually small residue of more difficult forms. The responsible reviser should indicate his or her assumptions of 'good species' or otherwise, and provide reasons for their decision, and that is all that can be done. Flagging these difficult taxa leaves the way open for more refined research that may elucidate their affinities. This is what I have done here, and my hope is that some of the uncertainties currently left unresolved may be addressed at a later date.

I conclude this section by simply noting that 'species' is the only category recognised by organisms other than human beings. Genera, families, orders, phyla, etc. are purely theoretical constructs and have no objective reality. If the entire tree of life, past and present, were to be reconstructed, and all the forms that link other forms were known, only 'species' could be separated at the end.

WHAT MAKES AN ANT AN ANT?

Ants belong to the insect order Hymenoptera, an order that also contains bees and wasps. Basically, hymenopterous insects can be distinguished from other insect orders (1) by the way that their first pair of wings is coupled to the second pair of wings (i.e. though rows of tiny hooks called hamuli found on the leading edge of the hind wing), and (2) by the close association of the first abdominal segment with the metathorax. In the Apocrita, the more advanced group of Hymenoptera that includes the ants, the first abdominal segment is actually incorporated into the metathorax and is usually separated from the remaining abdominal segments by a constriction, a true 'wasp-waist'!

Living ants constitute a single family, the Formicidae. One morphological character separates all adult ants from other Hymenoptera: this is the presence of a special mouth-pouch, the infrabuccal pouch. Since adult ants are not able to ingest solid food particles of any size, the infrabuccal pouch acts as a filter for such solid, particulate matter. In a few groups the pouch serves a special purpose, e.g. in leaf-cutter ant queens it acts as a carrier for fungal spores used as propagules for the fungus from which these ants feed. This character is small and difficult to see, but, fortunately, most ants possess other, more easily recognisable characters that, taken together, will separate them from other Hymenoptera. The most important of these are: (1) the presence of a metapleural gland, unique to ants, above the hind pair of coxae (secondarily lacking in many males and in the queens and workers of some formicine groups, e.g. sugar ants); (2) the presence of a wingless worker caste (secondarily lost in a few parasitic species that have queens and males only); (3) the possession of one or two discrete waist segments (the petiole and postpetiole), a character only shared with a few, mostly rare and minute wasps; and (4) elbowed ('geniculate') antennae in queens and workers.

In general, living ants are mainly seen by the layperson as wingless, social insects, quickly resolving any doubt as to their identity. The

following figures (Figures 2, 3 and 4) show the parts of the body found in the worker ant, the caste most often seen by the non-specialist. For purposes of economy, the terms are not explained here and the reader is referred to the glossary at the end of the monograph. Here I note, however, that in a few groups of ants, such as the subfamily Cerapachyinae, the postpetiole is not clearly defined. In these cases the abdominal segments are referred to by number. Additional information on various anatomical parts can be found in pp. 11–15 of Shattuck's (1999) Australian ant guide.

WHERE AND HOW DO ANTS LIVE IN THE SWBP?

This monograph will not repeat general information on the ant colony, life cycle, caste, task differentiation and other particulars that is already covered admirably by Shattuck (1999), Greenslade (1979) and Andersen (1991, 2000). However, the actual ecology and life histories of individual ant species in the SWBP are not merely poorly known; they are almost unknown.

What records exist are often those in which information on ants is incidental to that on other targeted organisms, very often the caterpillars of butterflies. Some additional information has been gleaned on granivorous species that eat seeds or arils (elaiosomes). What can be said with certainty is that very few SWBP ants nest within sound timber, such as the trunks of living trees and shrubs. Those that are known to do so include species of *Podomyrma*, *Ochetellus*, *Camponotus* (*C. macrocephalus* species-group and *Camponotus claripes nudimalis* Forel), at least one *Polyrhachis*, and several *Anonychomyrma* and *Crematogaster* species. Ants that live in twigs or small branches are even fewer.

While these wood-nesting ants probably utilize burrows in the wood made by beetle and moth larvae or other organisms, at least some ants may also enlarge existing chambers or even excavate new chambers in living timber: the author has seen workers of *Polyrhachis femorata* (F. Smith) removing fresh sawdust from their nest holes in a healthy jacaranda (see comments under 'Species Description').

By far the majority of ants in the SWBP live in soil, but others will occupy rotting wood, and *Pachycondyla* (*Brachyponera*) *lutea* (Mayr) is an example of a species that is frequently uncovered in termitaria, where workers prey on the termite brood or adults. In one nest of *P. lutea* uncovered north of Boxwood Hill (ESP) by the author, paralyzed adult termites, probably of *Coptotermes* sp. (Rhinotermitidae), were found. *Technomyrmex jocosus* Forel and species of *Ochetellus* and *Camponotus* will nest in dead wood or stone structures or under the bark of standing trees; other species may occupy crevices in rock or other materials. Although few ants actually nest in trees in the SWBP, many will forage on living trees and shrubs for prey, nectar and honeydew. While soil nesters can often be found under rocks and stones, recent research in the Perth area suggests that coarse woody debris (e.g. logs, branches and thick sheets of bark) may not be a preferred cover for most woodland ant species. However, this research is preliminary only.

The nest entrances of ants in the SWBP are very varied in construction, from mere holes in the ground, barely larger than the individual workers, to large mounds of small pebbles, several metres in diameter in the case of some meat ant species. The nests of some *Myrmecia* and *Rhytidoponera* species are built around the main stem of shrubs with a prostrate habit, which may give the upper levels of the nest added protection. The interface between soil and the large boles of tall eucalypts in laterite uplands is a favoured nest site for large *Camponotus* species such as *C. nigriceps* (F. Smith) and *C. dryandrae* McArthur and Adams. Nest entrances directly into soil are often more than mere holes: Some small, sand-nesting species, such as *Amblyopone clarki* Wheeler, extend their nest vertically to form a tiny turret of sand. At the other size extreme, clay turrets more than 30 cm high are constructed by a large *Myrmecia* sp. (probably *gratiosa* Clark) that lives in the Calingiri district. Sticks may be used in some nest constructions, and a large stick nest mixed with soil or pebbles is characteristic of the *Iridomyrmex conifer* species-group. Other ants, such as *Papyrius* spp., cover their runways along timber with frass. A tiny number of ants in the SWBP may follow an army ant life-way, though this is not known for certain. Judging from the author's observations, such may be the case for the blind *Cerapachys edentatus* (Forel) and, based on the biology of related overseas species, *Leptanilla swani* Wheeler.

Most ants in the SWBP are probably generalist scavengers, though, as mentioned above, this is a 'default' position in lieu of recorded observations. Dead and live arthropods, some vegetable material such as flowers, seeds or seed parts (especially elaiosomes), nectar and honeydew probably account for most of the food that ants in the SWBP eat. Elaiosome-collecting ants (rather than specialized seed harvesters) have been documented as very important seed dispersal and storage agents in the wetter parts of the SWBP. For example, in the northern Jarrah forest *Rhytidoponera inornata* Crawley and *Melophorus turneri perthensis* Wheeler (as '*Melophorus* ANIC sp. 1') were found to be the most significant ant species involved in this way (Majer 1982). Dacetine ants, which are speciose

though hardly numerous in the Province, are ambush hunters of small organisms such as springtails (Collembola). *Odontomachus ruficeps* F. Smith, not uncommon in drier areas of the SWBP, is an ambush hunter of larger prey. The meat ants, in addition to taking arthropods, probably also act as a disposal unit for dead vertebrates in bushland. Sluggish, minute forms, such as *Carebara* and *Discothyrea* are probably specialised food gatherers, perhaps of arthropod eggs (by analogy with studied species overseas; see also Greenslade 1979, Shattuck 1999), but nothing is known of the biology of the WA fauna.

PEST ANTS AND TRAMP ANTS

While the ant species present in an area are very often inoffensive and are rarely noticed by members of the public, a relatively small number of taxa are regarded as a human nuisance or worse. Ants can achieve such pest status in a number of ways: (1) they can cause injury through their bite or illness through their sting; (2) they can enter homes and other premises and invade food containers or refrigerators; (3) the same species that invade homes may vector disease, generally through mechanical means (i.e. through transporting pathogens on their hairs or cuticle and depositing these onto food or even into drips in hospitals); (4) some species are prone to chew through electrical wiring, causing damage and occasionally even precipitating dangerous situations in towns and cities (e.g. blackouts, or failure of vital electrical equipment); (5) introduced species can eradicate native invertebrates or even small vertebrates in disturbed sites, and, in some cases, areas of natural vegetation: a few (e.g. the Argentine ant) can also change the dynamics of floral communities by interfering with seed dispersal mechanisms; (6) some pest ants feed on cultivated fruits, vegetables and, more rarely, grains, while aggressive species may attack and even kill small domestic animals or young livestock: bee hives may also be raided by pest ants; (7) while many ants obtain much of their nutrition from honeydew, the watery faeces excreted by bugs (Order Hemiptera) that feed on plant sap, pest ant species are particularly effective at protecting such bugs, some of which are notorious as transmitters of plant viruses, and; (8) a few species (e.g. the extralimital black carpenter ant *Camponotus pennsylvanicus* (de Geer)) can cause structural damage to wood.

Some native ants carry moderately painful stings. (Incidentally, the sting in ants (and bees and wasps) is confined to females of the species, since it is no more than a modified ovipositor). Among the native stingers are various species of bulldog ants (*Myrmecia*) that can cause pain and occasionally an allergic reaction. Fortunately, Western Australia lacks those taxa, especially *Myrmecia gulosa* (Fabricius) and *Myrmecia pilosula* F. Smith, that make envenomation by bulldog ants a life-threatening issue in some of the eastern capitals. Other ants that can literally make their presence felt include *Rhytidoponera metallica* (F. Smith) and *Pachycondyla* (*Brachyponera*) *lutea*, but the stinging sensation is much less severe in these species. Biters are mostly species of *Iridomyrmex*, with meat ants (*Iridomyrmex purpureus* species-group) leading the way, mainly in rural areas. The large major workers of *Camponotus* can also draw blood with their mandibles, and *Camponotus terebrans* (Lowne) is an unusually aggressive sugar ant that, according to anecdotal information, is suspected of attacking patients in a Perth nursing home.

Ants that achieve pest status, apart from the stingers and biters, are often exotic. They include the so-called 'tramp ants'. True tramp species tend to have shared characteristics such as multiple queens in a nest, a wide range of food preferences, an ability to exist in ephemeral or strongly altered habitats (including urban areas), an ability to compete for food resources more successfully than native species, and a strong tolerance of other nests of their own species ('unicolonialism') but intolerance towards native ants. Typically, such ants disperse through budding off from existing colonies rather than through nuptial flights of queens. The literature on tramp ants is voluminous and increasing at a massive rate. For the interested reader, the anthologies by Vander Meer *et al*. (1990) and Williams (1994) provide a comprehensive introduction to applied myrmecological research, the latter including articles by Western Australian ant researchers on exotic ants in the SWBP.

Among the sorts of ants that constitute pests, the red imported fire ant (*Solenopsis invicta* Buren) is far and away the most injurious, being able to cause severe envenomation as well as environmental, horticultural and structural damage. Fortunately, this ant, although a major source of angst in Brisbane where it has been introduced, has not been recorded from WA thus far. Nonetheless, a survey of the literature and anecdotal reports (e.g. from the Department of Agriculture), as well as examination of the Curtin Ant Collection, reveals that at least eighteen ant species from five subfamilies have been introduced to the SWBP. Most of these species are from overseas. The origin of some of the introductions is obscure, but the most likely provenance of the best-known tramp ants is either India or South Africa (South America only in the case of the Argentine ant).

The majority of the pestiferous species occurring in the SWBP that are peridomestic nuisances, as opposed to stingers and biters, belong to the subfamilies Dolichoderinae, Formicinae and

Myrmicinae. The most serious of the dolichoderine pests is the Argentine ant (*Linepithema humile* (Mayr)). This species has increased rapidly in the Perth region in recent years, possibly coinciding with the cessation of heptachlor spraying (e.g. Majer and Brown 1986; May and Heterick 2000; Heterick *et al*. 2000). *Technomyrmex jocosus* Forel, for long confused with its notorious sister, the white-footed house ant, *Technomyrmex albipes* (F. Smith), is an Australian native (perhaps also a WA native) with invasive habits. This species may occur naturally on or near the south coast of WA, but was described from Victoria. Around Perth it is most commonly seen on trees and fences and will enter homes and even make its nest in car engines (such as one belonging to the author!). Fortunately, it is not normally implicated in structural damage. *Tapinoma melanocephalum* (Fabricius), which belongs to a genus that is easily confused with *Technomyrmex* because of the lack of a petiolar node, is primarily a pest of the tropics. However, the author is aware of one Perth record of this species from disturbed urban parkland and another from a flowerpot. Among native species, *Iridomyrmex chasei* Forel nests on open ground but will forage in homes and so qualifies as a minor pest, while *Ochetellus glaber* group sp. JDM 19 often lives up to its common name of Little black house ant in the SWBP. *Papyrius nitidus* (Mayr) is another occasional dolichoderine pest in ceilings and wooden structures in the SWBP.

Probably the most commonly seen of the introduced formicines in the Perth area is a large, black *Paratrechina*. The ant, native to the eastern states and to the north of WA, is awaiting positive confirmation from Dr. Steve Shattuck (ANIC), but could be *Paratrechina obscura* (Forel). This species is often seen in parks and gardens and other urban microhabitats where a humid environment is artificially maintained. *Paratrechina longicornis* (Latreille) is a potentially more serious pest, but is fortunately rare in Perth, although the author has collected it from the heart of Fremantle. This species is very common near the Broome region in the Kimberley, and has been introduced to Barrow Island. *Paratrechina braueri glabrior* (Forel), known from one specimen collected by the author a number of years ago from the Point Walter foreshore on the Swan River, is probably a non-native in the Perth region, although it is a common species in the north and north-west of WA. The notorious carpenter ant, *Camponotus pennsylvanicus* De Geer, has been intercepted by WAQIS officers, but is not included among the imports, as it has not established nests in this State. Native formicines rarely come under notice, but a few *Camponotus* spp., most notably *Camponotus claripes nudimalis* Forel, will enter houses looking for sweet foods, scraps and even dead insects. Ants being what they are, however, unpleasant surprises cannot be ruled out: the author has had *Notoncus gilberti* Forel from an outdoor nest raid a food cupboard in his home – by all accounts unparalleled behaviour for this normally inoffensive formicine!

Myrmicines include the largest number of pest species in the SWBP, and some of these, like the aforementioned red imported fire ant, also carry an unpleasant sting. The recent destruction of nests of *Solenopsis geminata* (Fabricius) near the centre of Perth by Department of Agriculture officers hopefully has prevented the establishment of this venomous species here, and the same may apply to *Monomorium floricola* (Jerdon), which undoubtedly also occurs in the tropical areas of the State. Other noxious myrmicines, unfortunately, are well established. These include the notorious coastal brown or big-headed ant (*Pheidole megacephala* (Fabricius)). The latter species is certainly the best known of the introduced ant pests in the wider Perth area, and is responsible for the great bulk of complaints about house-infesting ants received by the WA Department of Agriculture (M. Widmer, pers. comm.). Two other major cosmopolitan pests, the Singapore ant (*Monomorium destructor* (Jerdon)) and the Pharaoh ant (*Monomorium pharaonis* (L.)) also occur in Perth, but for whatever reasons have not achieved the notoriety here that they have achieved elsewhere in the world.

Other exotic myrmicines of lesser pest status, e.g. *Tetramorium bicarinatum* (Nylander), *Tetramorium simillimum* (Smith) and a couple of *Pheidole* spp. rarely come under notice, and seem to live amicably with the natives. *Cardiocondyla 'nuda'* (Mayr) is possibly an introduced species, but is another inconspicuous member of the local ant fauna. The few apparently introduced taxa that belong to other subfamilies, e.g. *Cerapachys longitarsus* (Mayr) and *Hypoponera eduardi* (Forel) (the identity of the latter has to be confirmed, though it is most likely exotic) are likewise inoffensive.

ANTS AS BIOINDICATORS

Because of their ubiquity, their abundance, the ease with which they may be trapped, and their relatively simple identification (genitalia mounts and the like are not required), ants have been favoured as environmental indicators in Australia for a number of years now. Since the first paper on the use of ants as bioindicators (Majer 1983), studies using ants in this way have focussed on aspects of land rehabilitation (e.g. following mining or grazing), general environmental management and the effects of burning regimes or wildfire. In a series of seminal papers, P. J. M. Greenslade (1978) and Alan Andersen (e.g. 1990, 1991b , 1995) have placed ants used for monitoring purposes in discrete guilds called 'Ant Functional Groups'.

These Groups represent the supposed roles of the various ant taxa in the Australian environment, and are mostly predicated by taxon behaviour or preferred environment, e.g. 'Subordinate Camponotini' or 'Cold Climate' and 'Hot Climate Specialists'. Andersen has also suggested analogies between Ant Functional Groups and vegetation forms (Andersen 1995). The resolution of the groups, originally based mostly on entire ant genera, has been refined in successive publications. Now, some genera have been split, as more biological information on individual species-groups within these genera becomes available.

Because of the applied nature of the Department of Environmental Biology at Curtin University, that department has been at the forefront of much of the research in Australia that uses ants as bioindicators. Typically, trapping involves the use of vials as pitfall traps, and in recent years many studies have involved Curtin University students. As a sideline of this work, the ant fauna of the SWBP has been extensively sampled in most major ecosystems that occur within the SWBP, although faunal systems in the south-east and north-east of the Province are less well-known.

Valuable as it has been as a collecting tool and monitoring device, however, straight-forward pitfall trapping has severe limitations when seen from a taxonomic or even a conservation perspective. Individual ant workers collected in vials cannot be assigned to nests, thus limiting information on variability within an ant species, major and minor workers of polymorphic species cannot readily be matched, and valuable information on the behaviour of living individuals is absent. An increasing concern is the unwanted by-catch collected by large pitfall traps, especially when this includes small vertebrates or potentially endangered invertebrates from relictual bushland areas within suburbia. The way of the future in all of this work requires that more refined and varied trapping methods need to be adopted, with modifications to prevent ingress of small vertebrates into pitfall traps (where these are still used). Also desirable would be a greater emphasis on studies of live ant populations, as well as theoretical analysis of the Ant Functional Group concept, so as to give it greater scientific rigour; the more so as costs and overheads become increasingly important to farmers, industrialists and conservationists.

The remainder of this monograph will be devoted to the taxonomic keys and discussion of the physical characteristics and behaviour of the species found in the SWBP. The subfamily keys and discussion follow Bolton (2003), the subfamilies being introduced in order of their earliest fossil record as at the time of Bolton's publication.

KEY TO THE ANT SUBFAMILIES OF THE SOUTH-WEST BOTANICAL PROVINCE

1. Dorsum of pygidium flattened, margins of flattened area armed laterally, posteriorly, or both, with a series of denticles or short spines (Figure 5); abdominal segments V – VII with spiracles visible in intact specimen; promesonotal suture usually completely absent (absent in all known Australian species)..... **Cerapachyinae**

   Dorsum of pygidium without series of denticles or short spines; abdominal segments V – VII with spiracles visible only when abdomen is distended or dissected (except for Aenictinae) (e.g. Figures 6, 7); promesonotal suture present or absent **2**

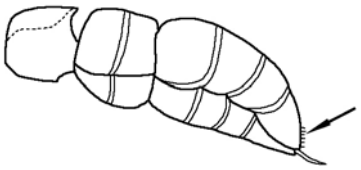

Figure 5

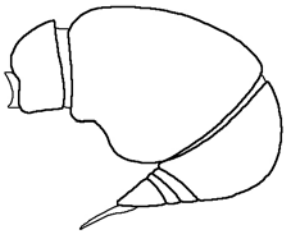

Figure 6

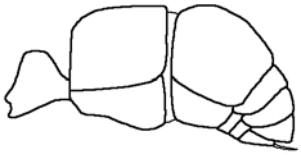

Figure 7

2. Waist consisting of a single distinct segment (the petiole); abdomen may be more-or-less deeply impressed behind segment III (Figures 2, 7) **3**

   Waist consisting of two distinct segments (the petiole and postpetiole), segment III being distinctly separate from remaining abdominal segments, which are smoothly rounded (Figure 3) **10**

3. Apex of hypopygium with a circular or semicircular cone (the acidipore), usually projecting as a nozzle and modified to spray formic acid and often fringed with hairs (Figures 8, 9)..... **Formicinae**

Apex of hypopygium without an acidipore..... **4**

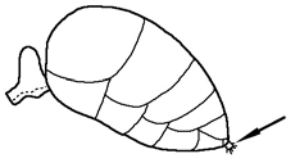

Figure 8

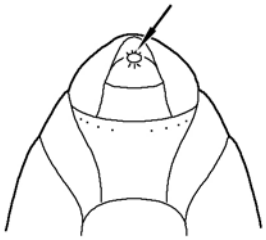

Figure 9

4. Apex of abdomen (junction of hypopygium and pygidium) with a transverse slit (Figures 10, 11); abdomen without an impression between the third and fourth abdominal segments, often soft, flexible and easily collapsed; mandibles triangular with teeth along entire inner margin.....**Dolichoderinae**

   Apex of abdomen with a sting; abdomen may be deeply impressed between third and fourth abdominal Segments (Figure 7); cuticle stronger, less flexible, not normally collapsible; mandibular shape various..... **5**

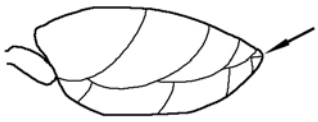

Figure 10

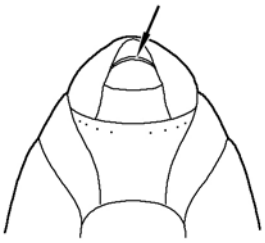

Figure 11

5. Petiole broadly articulated to abdominal segment III (Figure 12); dentiform (i.e. tooth-like) clypeal setae present (Figure 13) (one genus, *Amblyopone*)..... **Amblyoponinae**

   Petiole with distinctly descending posterior face; dentiform clypeal setae absent **6**

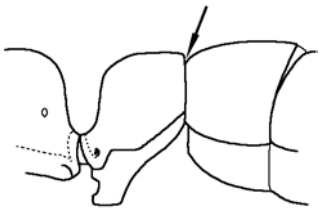

Figure 12

Figure 13

6. Petiole approximately as long as to slightly longer than abdominal tergite III (Figure 14); mandibles elongate-triangular, intermeshing (15 or more small teeth present) (Figure 15) ....**Myrmeciinae (pt.)**

   Without the above combination of characters..... ..... **7**

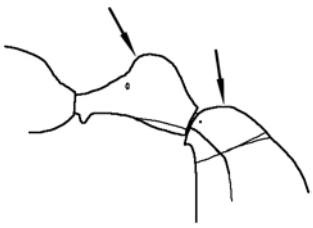

Figure 14

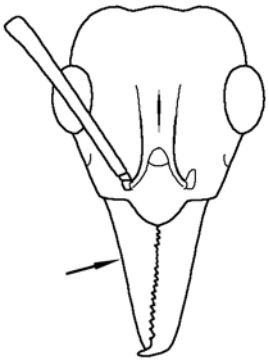

Figure 15

7. In profile, metapleural gland orifice a longitudinal to oblique curved slit or crescent, directed upward by a strip of cuticle (Figure 16) (one genus, *Rhytidoponera*) ....**Ectatomminae**

In profile, metapleural gland orifice elliptical to circular and opening laterally or posteriorly, not bounded by strip of cuticle that directs orifice upward (Figure 17) **8**

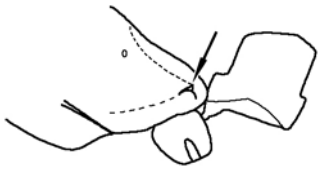

Figure 16

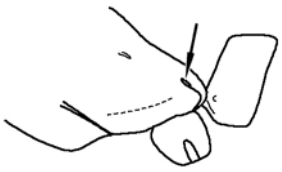

Figure 17

8. Promesonotal suture either completely absent or present and reduced and fully fused, so pronotum and mesonotum are incapable of independent movement (Figure 18); antennal sockets mostly to completely exposed (Figure 19) (one genus, *Discothyrea*) ..... **Proceratiinae**

Promesonotal suture fully developed, so pronotum and mesonotum capable of independent movement (Figure 20); antennal sockets covered by developed frontal lobes (Figure 21)..... **9**

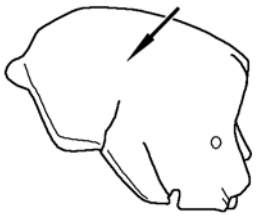

Figure 18

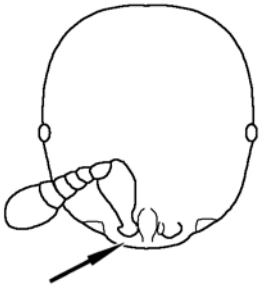

Figure 19

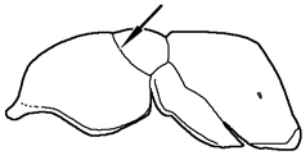

Figure 20

9. Torulus of antenna completely fused to frontal lobe; frontal lobes are rounded or triangular, and in full-face view have a decidedly 'pinched in' appearance posteriorly (Figure 21); anterior clypeal margin without lamellate rim; in full-face view, head capsule without median longitudinal carina (Figure 22) ..... **Ponerinae**

Torulus of antenna not completely fused to frontal lobe; frontal lobes not rounded or triangular in appearance, and not 'pinched in' posteriorly, anterior clypeal margin with lamellate rim; in full-face view, head capsule with median longitudinal carina (one genus, *Heteroponera*) ..... **Heteroponerinae**

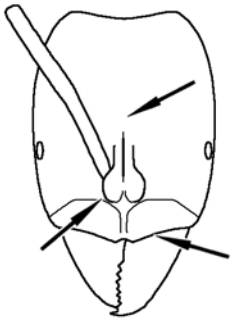

Figure 21

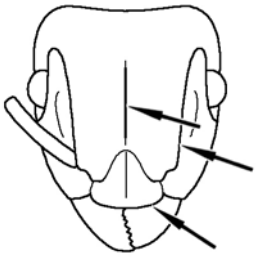

Figure 22

10. Mandibles long and more or less linear, usually with teeth along entire inner margin; eyes very large, situated on or near the anterior margin of the clypeus (Figure 23) ..... **Myrmeciinae (pt.)**

Mandibles usually triangular, but if elongate, then without teeth on inner margin (teeth at mandibular tip only), and eyes small or medium-sized, situated away from anterior margin of clypeus **11**

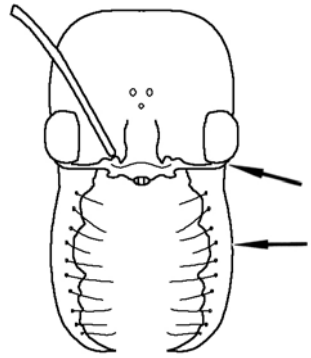

Figure 23

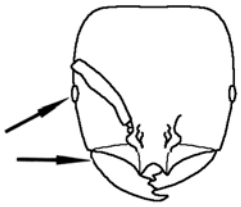

Figure 24

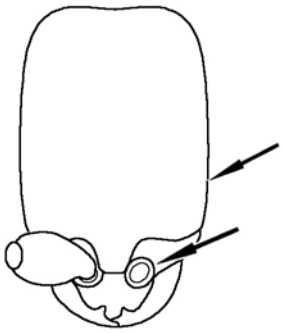

Figure 25

11. Eyes normally present, but if absent then frontal lobes expanded so that the latter cover all or part of antennal insertions (Figure 24) **12**

    Eyes absent or represented by a single facet; frontal lobes absent, so that the antennal insertions are completely exposed (Figure 25) **13**

12. Pronotum and mesonotum fused to form one segment (the promesonotum) (Figure 26); hind tibiae with at most a simple spur, but this may be lacking; tarsal claws simple (Figure 27) ....**Myrmicinae**

    Joint between pronotum and mesonotum flexible (Figure 28); hind tibiae with pectinate spurs; tarsal claws toothed (Figure 29) (one genus, *Tetraponera*)..... **Pseudomyrmecinae**

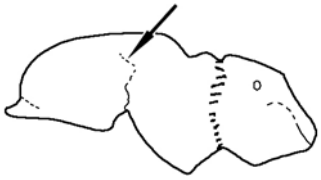

Figure 26

Figure 27

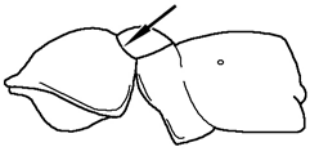

Figure 28

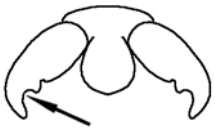

Figure 29

13. Pronotum and mesonotum fused to form one segment; antennae 10-segmented; length greater than 3 mm (Figure 30) (one genus, *Aenictus*)..... **Aenictinae**

    Joint between pronotum and mesonotum flexible (Figure 31); antennae 12-segmented; length less than 2.5 mm (one genus, *Leptanilla*) .... **Leptanillinae**

Figure 30

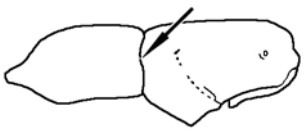

Figure 31

PLATES

Plates 1-6: Botanical Districts of the SWBP. **1**, Avon wheatbelt: a rich ant habitat – note strongly stratified vegetative structure. **2**, Esperance sand plain: the low canopy height means most ant species are epigaeic foragers. **3**, Geraldton sandplain: the kwongan, in particular, is an endemic floral hotspot and has a rich ant fauna with many sandplain species. **4**, Jarrah forest: the ant fauna of this district is probably the best known among the respective districts. Ant diversity appears greatest on the eastern side of the Darling scarp. **5**, Mallee: the ant fauna of this sparsely settled region is not well known and could yield surprises. **6:** Swan coastal plain: the ant fauna largely mirrors that of the southern sector of the Geraldton sandplain, with many species in common (B. E. Heterick).

Plate 7 Warren: ant diversity is low in this cool, wet district, but the presence of a number of rare and specialised endemics gives it particular significance to the student of ants. (B. E. Heterick)

Plate 8 Rare, undescribed Notoncus species (*Notoncus* sp. JDM 487), currently only known from a tiny reserve in suburban Perth (B. E. Heterick)

Plate 9 Exposed gallery of native carpenter ants (*Camponotus claripes nudimalis* Forel) in trunk of red-flowering gum (*Corymbia calophylla* (Lindl.) K. D. Hill & L. A. S. Johnson) (B.E Heterick)

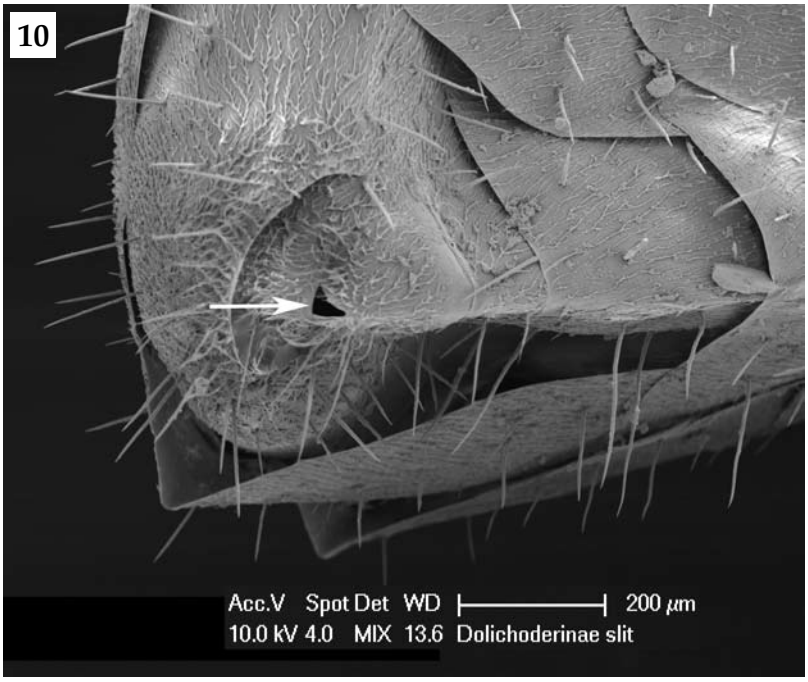

Plate 10 Slit under gaster of meat ant (Dolichoderinae: *Iridomyrmex*): a cocktail of powerful chemicals exuded from this slit help to subdue prey or enemies.

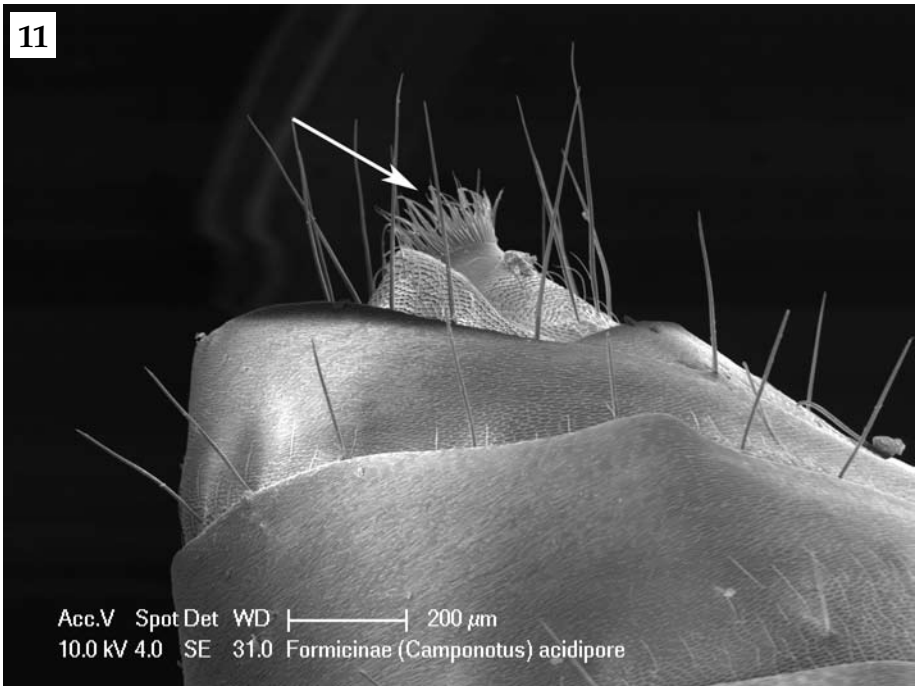

Plate 11 Acidipore of sugar ant (Formicinae: Camponotus): this structure directs an aerosol of corrosive formic acid at attackers.

Plate 12 Full-face view of head of typical bulldog ant (Myrmeciinae: *Myrmecia*) showing the formidable mandibles. However, what is often referred to as the 'bite' of the bulldog ant is the consequences of the sting at the other end!

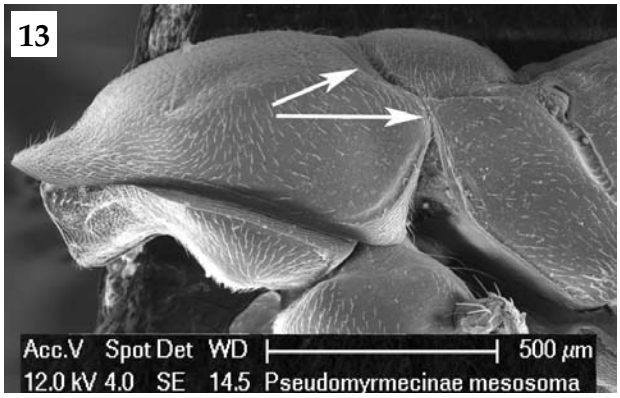

Plate 13 *Tetraponera* (Pseudomyrmecinae) worker showing the flexible joint of the pronotum and mesonotum. In superficially similar myrmicine ants the joint is fused.

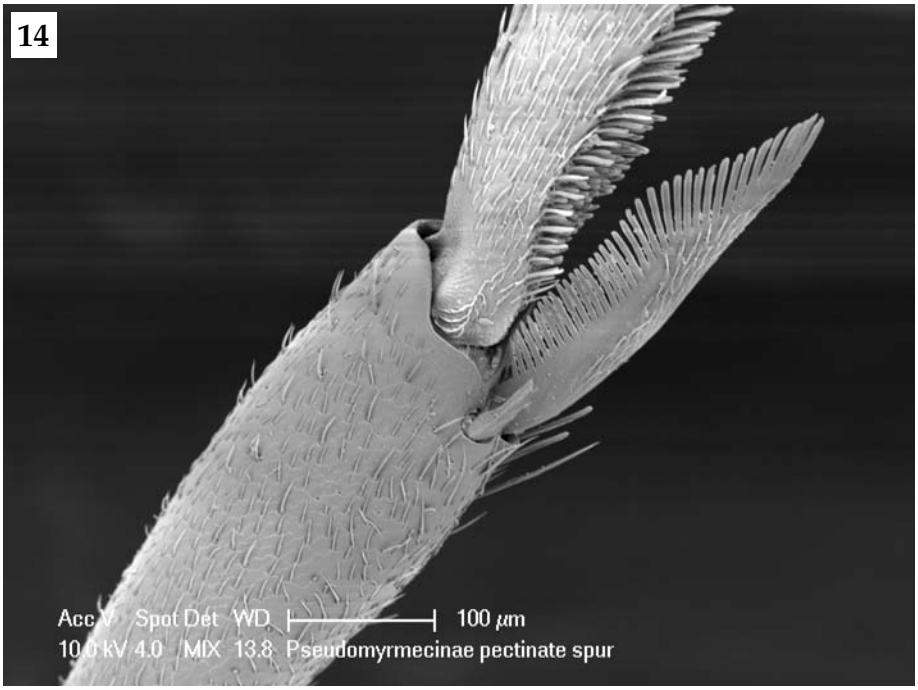

Plate 14 Pectinate tibial spur of *Tetraponera*, another typical pseudomyrmecine feature (same worker as in Plate 13).

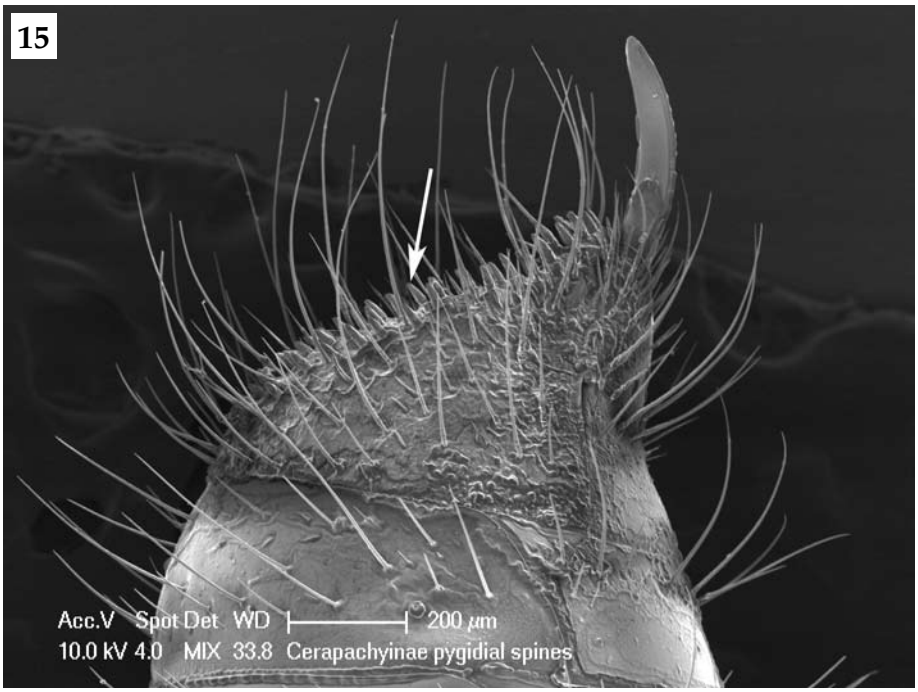

Plate 15 Pygidial spines in *Cerapachys* (Cerapachyinae).

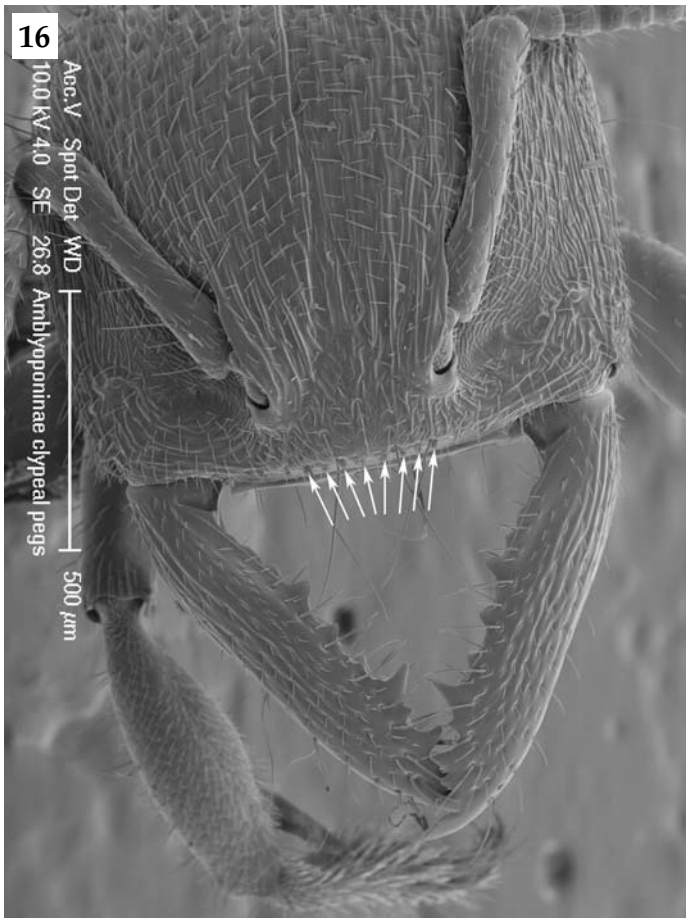

Plate 16 Full-face view of *Amblyopone* (Amblyoponinae) showing the clypeal pegs (dentiform setae), a diagnostic feature of this subfamily.

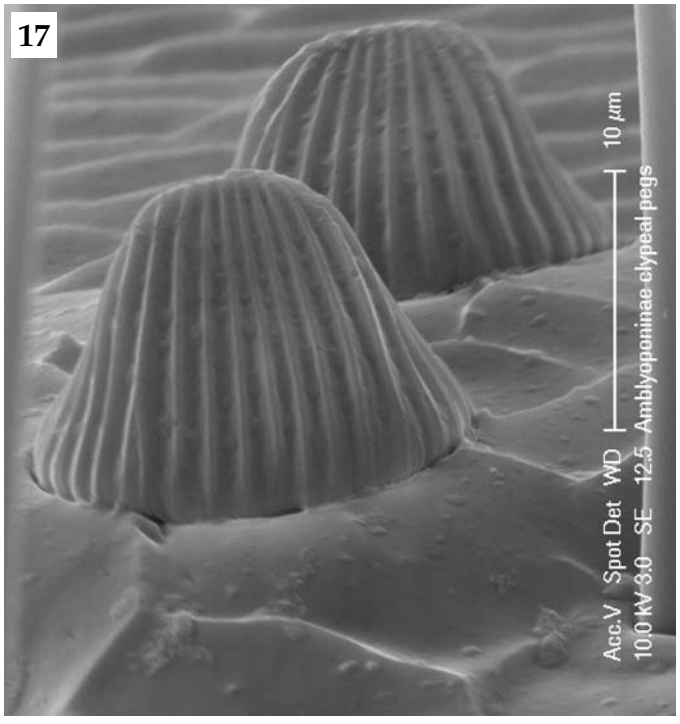

Plate 17 Two clypeal pegs from *Amblyopone* (same worker as shown in Plate 16) seen under high magnification. These modified setae may be gustatory (taste) receptors.

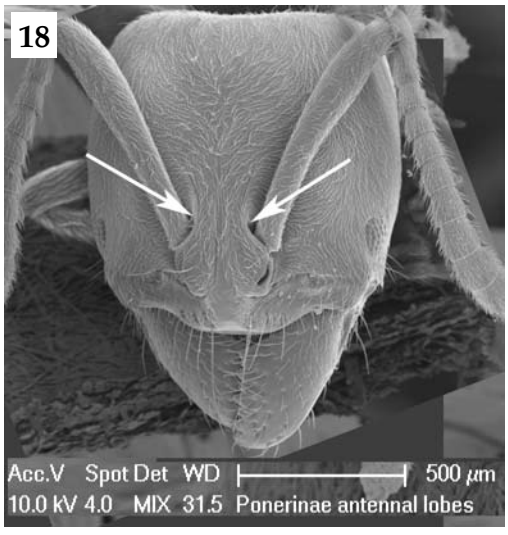

Plate 18 'Pinched-in' frontal lobes typical of ponerine ants (Ponerinae: *Pachycondyla*).

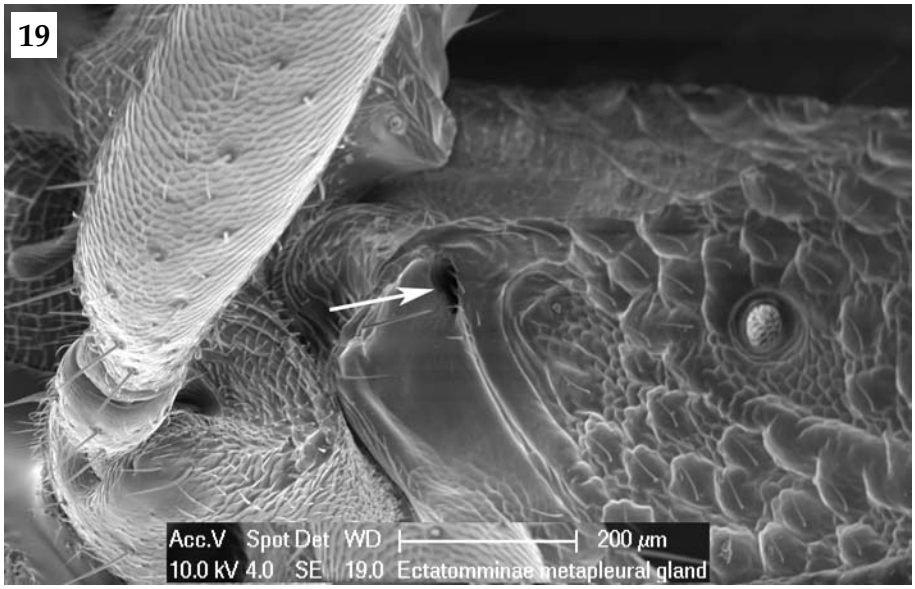

Plate 19 Detail of propodeum of ectatommine ant (Ectatomminae: *Rhytidoponera*), revealing the strip of cuticle characteristic of this subfamily that directs the orifice of the metapleural gland dorsally or posterially. A white arrow denotes the orifice of the metapleural gland.

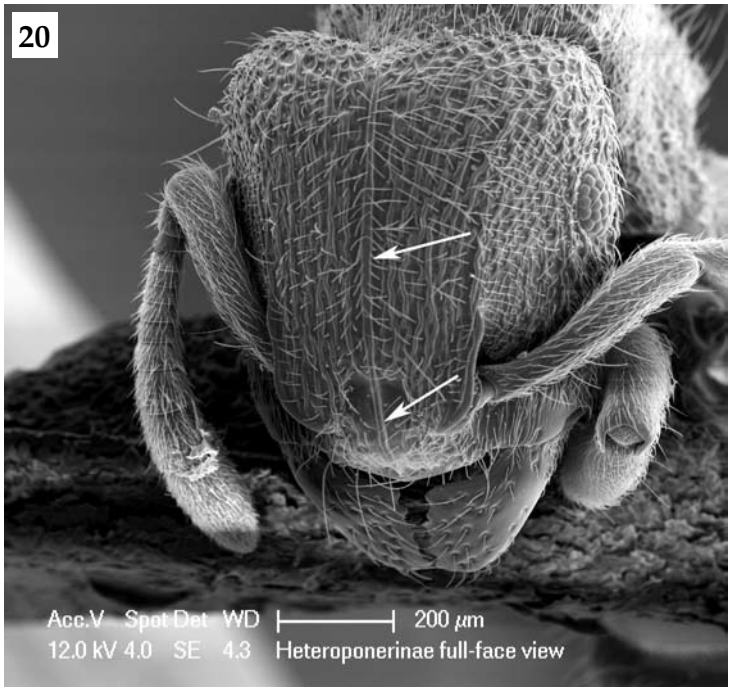

Plate 20 Full-face view of a heteroponerine worker (Heteroponerinae: *Heteroponera*) revealing the median longitudinal carina that runs the length of the head capsule

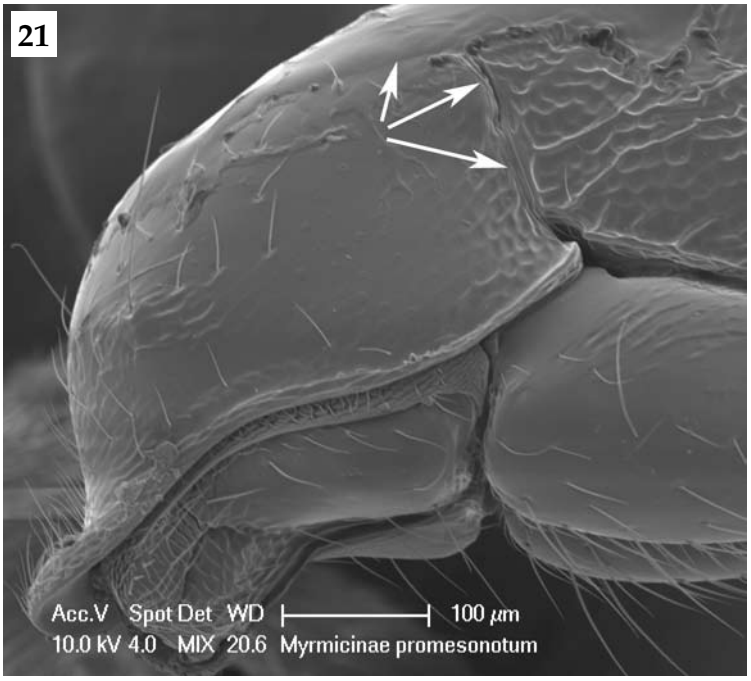

Plate 21 The promesonotal suture of this myrmicine worker (Myrmicinae: *Monomorium*) is evident in this specimen but fully fused, so that pronotum and mesonotum form a promesonotum (the join is arrowed). Often, the suture is completely absent.

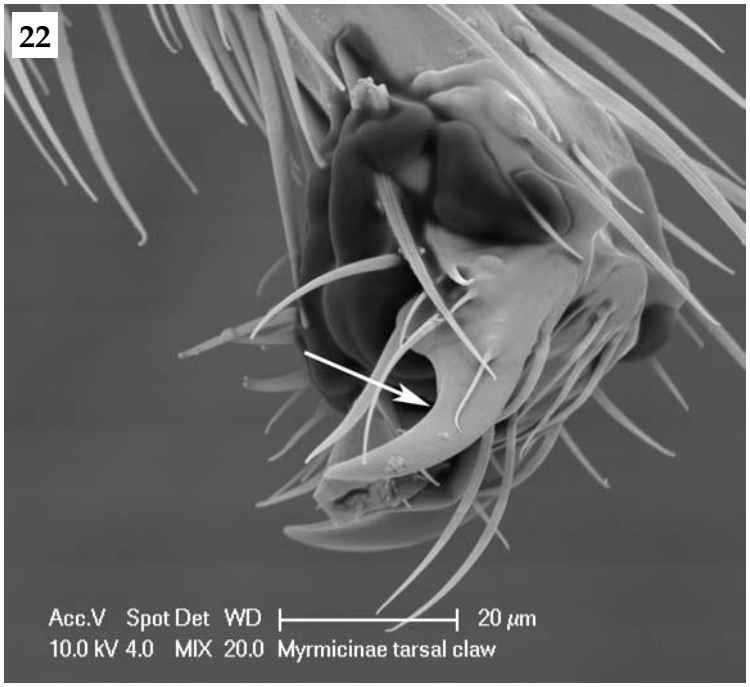

Plate 22 Simple claw of myrmicine (same worker as illustrated in Plate 21). (All SEM photographs E. Miller, Curtin University)

KEY TO THE ANT GENERA OF THE SOUTH-WEST BOTANICAL PROVINCE

This key is designed to enable researchers to identify ants of south-western Australia to genus, and may not have validity for species found in northern or eastern Australia. Only subfamilies with multiple genera occurring in the SWBP are included in this key. (n.b. The orientation of Figures 38a, 39, 40, 51, 52, 65, 66, 67, 79, 80 follows Shattuck (1999), as these orientations show diagnostic features most clearly.)

(a) Dolichoderinae:

1. Petiole without a distinct node (Figure 32); posterior margin of clypeus a broad, even arc (Figures 184, 185) **2**

   Petiole with a distinct node (Figure 34), or, if node weakly indicated (Figure 33), posterior margin of clypeus elliptical or forming a shallow rectangle, with medial sector often more-or-less straight (Figures 133b, 134b) **3**

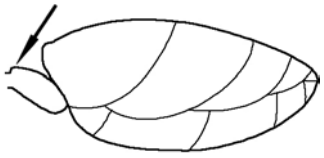

Figure 32

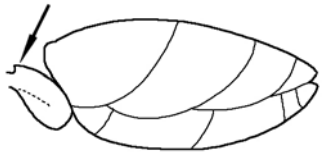

Figure 33

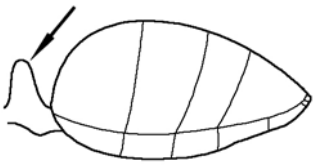

Figure 34

2. Gaster with five plates (tergites) on its upper surface (Figure 32); pronotum generally with erect setae; larger (≈ 3 mm); black..... ..... ***Technomyrmex***

   Gaster with four plates on its upper surface (as in Figure 33); pronotum without setae in WA spp.; smaller (1–1.5 mm); brown or yellowish ..... ***Tapinoma***

3. Propodeal angles produced as distinct spines on the same plane as the mesosoma (Figure 35); ant red-and-black ..... ***Froggattella***

   Propodeal angles usually not produced as spines (eg. Figures 36, 37), if spines present then not on same plane as the mesosoma and ant with black body **4**

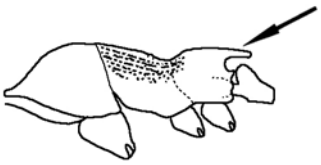

Figure 35

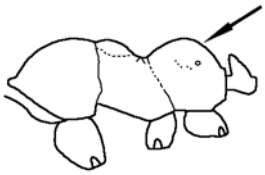

Figure 36

Figure 37

4. Underside of head near mandibular insertion with a weak to well developed flange (Figures 38a); head and mesosoma usually strongly sculptured; propodeum often concave (Figure 38b) or propodeal angle produced as spines) (Figure 38c)..... **Dolichoderus**

   Underside of head near mandibular insertion rounded or with a ridge, but never with a flange (Figure 39); head and mesosoma at most with very weak shagreenate sculpture; propodeum usually rounded, may be concave but never with spines **5**

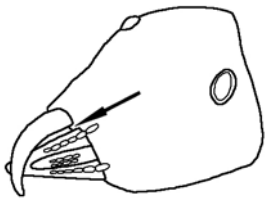

Figure 38a

Figure 38b

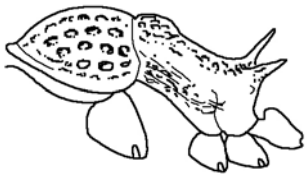

Figure 38c

5. Palps very short (PF 2,2) (Figure 40); eyes small (about 50 facets); clypeus with several to many downwardly curved setae which are about the same length as the closed mandibles..... ..... ***Arnoldius*** **(formerly, *Bothriomyrmex*)**

   Palps longer (PF 6,4 or 5,3) (see Figure 39); eyes generally larger (50 facets >); clypeus (except *Nebothriomyrmex*) with several to many short, occasionally curved setae, which are much shorter than the closed mandibles **6**

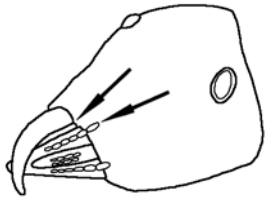

Figure 39

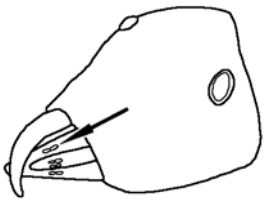

Figure 40

6. Declivitous face of propodeum concave (Figure 41); head and mesosoma usually dull black, gaster often shiny with purple or blue iridescence, very rarely with red head and mesosoma, black gaster; nearly always associated with wood or man-made structures ..... **Ochetellus**

   Declivitous face of propodeum never concave, propodeum usually rounded, occasionally flattened or square (Figures 42, 43); often brown, black or bicoloured, appearance rarely as above; most species ground nesting..... ..... **7**

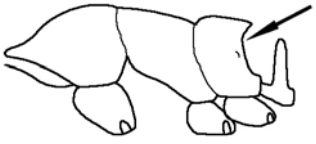

Figure 41

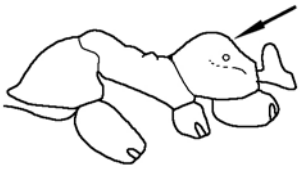

Figure 42

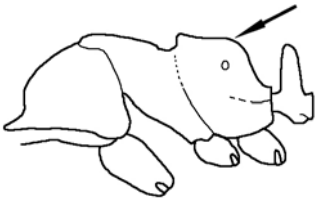

Figure 43

7. Mesosoma consisting of three compact segments, the two thoracic segments higher than long with the propodeum often obliquely flattened; petiolar node a small to minute scale, sometimes barely visible (ant very *Tapinoma*-like) (Figure 37); small to minute species (≈ 1–1.5 mm) **8**

   Mesosoma not so compact, the propodeum in particular broader, at least as high as long, and generally rounded or square; petiolar node more robust (see Figures 42, 43); most species of at least medium size (2–5 mm) **9**

8. Pronotum rising abruptly at approximately 90° to form a small protuberance (Figure 44); eyes small (≈ greatest width of antennal scape)..... ..... ***Nebothriomyrmex***

   Pronotum moderately to strongly convex but not rising abruptly to form a protuberance (Figure 45); eyes large (2 × greatest width of antennal scape ≥) ..... ***Doleromyrma***

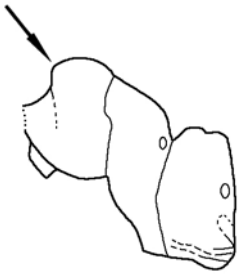

Figure 44

Figure 45

9. Palps shorter (PF 5,3); propodeum square in shape, sometimes with small lip anteriad (Figure 43); odour of fresh specimens aromatic (like perfume); colony often covers its nests and trails with frass (plant fibres, chewed up wood fragments and faeces)..... ***Papyrius***

   Palps longer (PF 6,4); propodeum at least gently rounded (Figure 42); fresh specimens either without odour or with strong acrid or chemical odour, rarely that of perfume; colonies do not use frass **10**

10. Anterior margin of clypeus with central protuberance (lacking in one black, iridescent species with a low broad node and propodeal spiracles placed at the propodeal angles); eyes placed rather high on sides of head capsule (about the mid-point) (Figure 46) ..... ***Iridomyrmex***

    Anterior margin of clypeus without a central protuberance, either broadly convex, straight or broadly concave; eyes placed below mid-point of head capsule (Figures 47, 48)..... ..... **11**

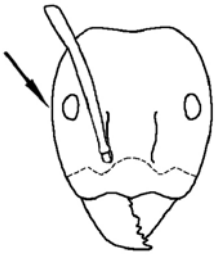

Figure 46

Figure 47

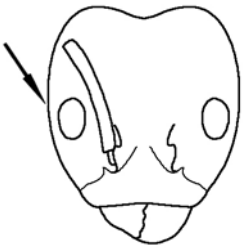

Figure 48

11. Outline of mesosoma smooth except for gently rounded propodeum (Figure 49); widest point of head capsule above eye; posterior margin of head capsule slightly concave or straight (Figure 47); brown ants; little or no odour; exotic tramp species found mostly in highly disturbed environments ..... ***Linepithema***

    Outline sinuate (strongly rounded propodeum and usually also mesonotum) (Figure 50); widest point of head capsule near eye; posterior margin of head capsule moderately to strongly concave (Figure 48); black ants; strong chemical odour; native species found in woodland..... ***Anonychomyrma***

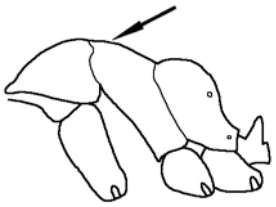

Figure 49

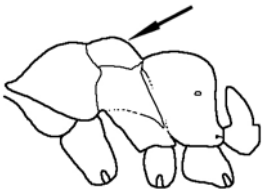

Figure 50

(b) Formicinae:

1. Antenna with 10 or 11 segments (including the scape) **2**

   Antenna with 12 segments (including the scape) **4**

2. Palps short (PF 2,3) (Figure 51); eyes minute; soft-looking, yellowish ants with large gaster (SW species rarely collected, probably spends most of its life underground; also in the Kimberley region)..... ***Acropyga***

   Palps long (PF 6,4) (Figure 52); eyes normal size; other features variable **3**

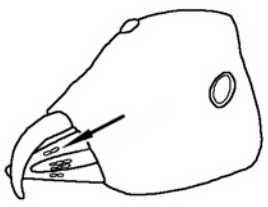

Figure 51

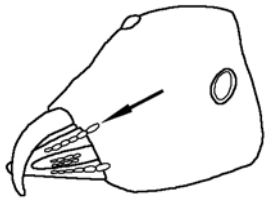

Figure 52

3. Propodeum with one or more pairs of spines, teeth or protuberances, often including pair over propodeal spiracle; petiolar node often with pair of spines or lateral processes (Figure 53) ..... ***Stigmacros***

   Propodeum and petiolar node always without spines, teeth or protuberances. (Figure 54) ..... ***Plagiolepis***

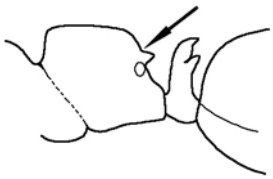

Figure 53

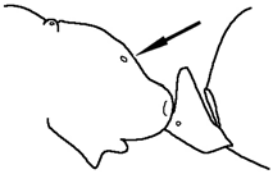

Figure 54

4. Lower corner of mesosoma below propodeum without an opening (to the metapleural gland) fringed with long setae, though a few scattered setae may be present (Figure 55) **5**

   Lower corner of mesosoma below propodeum, just above hind coxa, with an opening that is often fringed with long hairs (Figure 56) **6**

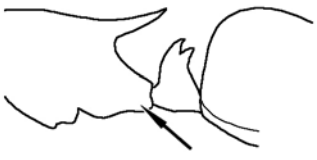

Figure 55

Figure 56

5. Upper plate of first gastral segment (first tergite) approximately half total length of gaster; spines or sharp angles present on propodeum and petiolar node (Figure 57); one worker caste..... ***Polyrhachis***

   Upper plate of first gastral segment much less than half total length of gaster; spines always absent on body segments in West Australian species; propodeal angle (if present) rounded (Figure 58); major and minor worker castes, at least, always present, media workers often present ..... ***Camponotus***

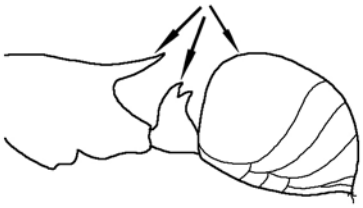

Figure 57

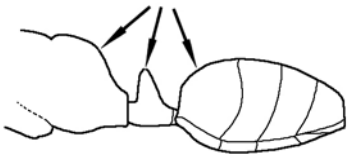

Figure 58

6. Eyes very large and placed on posterior corners of head capsule (Figure 59)..... ***Opisthopsis***

   Eyes of moderate size and placed at sides or front of head capsule, but not near posterior corners (Figure 60) **7**

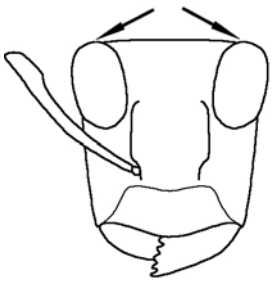

Figure 59

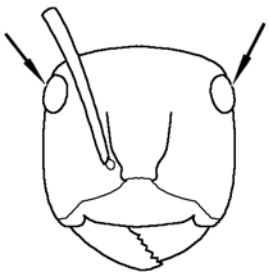

Figure 60

7. Antennal sockets separated from the posterior margin of the clypeus by a distance greater than the smallest diameter of the antennal scape (Figure 61) ..... ***Calomyrmex***

   Antennal sockets very close to posterior margin of the clypeus separated, at most, by a distance less than the smallest diameter of the antennal scape (Figure 62) **8**

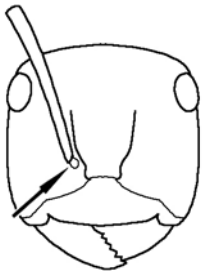

Figure 61

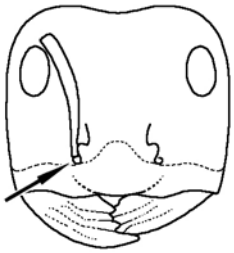

Figure 62

8. Propodeal spiracle slit or comma-like (Figure 63a); clypeus and underside of head and mandibles usually with profuse, long, curved hairs (Figure 63b); major, media and minor castes present (i.e. species polymorphic); species very active in the heat of the day ..... ***Melophorus***

   Propodeal spiracle oval or round (Figure 64); clypeus and underside of head and mandibles with few or no long curved hairs; single worker caste (i.e. species monomorphic) **9**

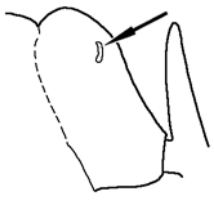

Figure 63a

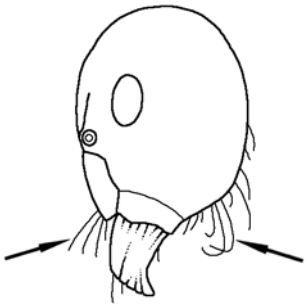

Figure 63b

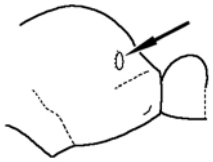

Figure 64

9. Dorsum of head, pronotum and mesonotum, at least, with multiple conspicuously paired, stout, dark setae (the latter also present on propodeum in *P. minutula* group) (Figure 65); ocelli very small to absent in WA species ..... ***Paratrechina***

   Dorsum of head, pronotum and mesonotum usually with well-separated, thin, pale setae (Figure 66) (setae sometimes lacking), but if stout and dark, then maximum of one or two conspicuously paired pairs on pronotum (Figure 67); two or three ocelli placed in a triangle usually evident **10**

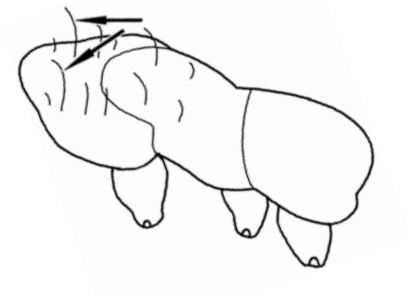

Figure 65

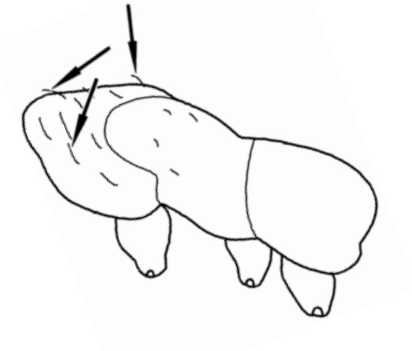

Figure 66

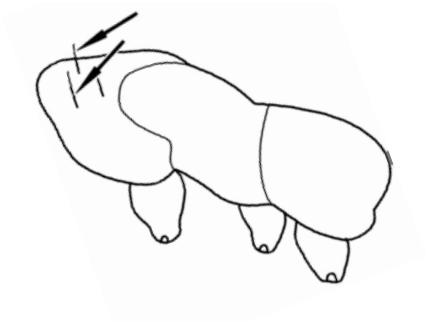

Figure 67

10. Propodeal spiracle located near posterior face of propodeum (Figure 68a); antennal scapes exceed posterior margin of head capsule by more than one third of their length (Figure 68b); outline of mesosoma smooth ..... ***Prolasius***

    Propodeal spiracle located at least its diameter anterior of the posterior face of the propodeum (Figure 69); antennal scapes exceed posterior margin of head capsule by less than one third of their length (Figure 70); mesosoma often with processes on pronotum..... **11**

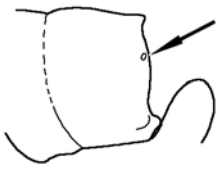

Figure 68a

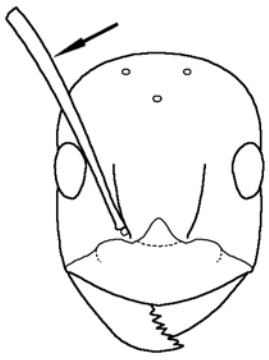

Figure 68b

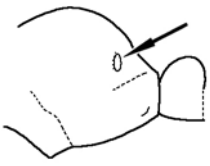

Figure 69

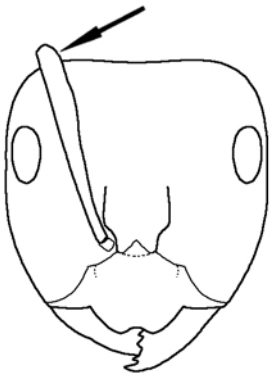

Figure 70

11. Projecting central anterior margin of clypeus rectangular; frontal carinae distinctly arched; mandible with 10–13 teeth in minors, as few as six in majors; frontal carinae strongly arched (Figure 71); workers polymorphic; dorsum of mesosoma always smooth in outline (rare, SW and eastern wheatbelt) ..... ***Myrmecorhynchus***

    Anterior margin of clypeus convex or sinuate in outline, often with a central notch or groove; mandibles with six or seven teeth; frontal carina weakly arched or straight (Figure 72); workers monomorphic in Western Australian species (one or more Eastern states species weakly polymorphic); dorsum of mesosoma may have angular or rounded pronotal and metanotal processes ..... ***Notoncus***

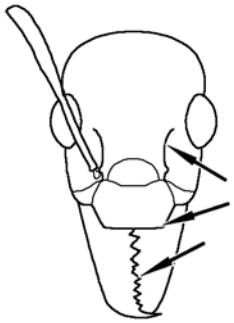

Figure 71

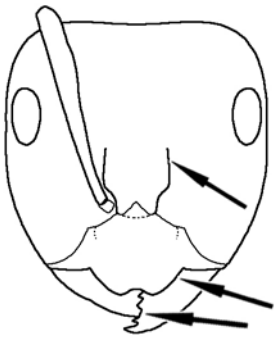

Figure 72

(c) Myrmeciinae

1. Mandibles elongate-triangular with many tiny, intermeshing teeth along their entire margin; eyes placed well above posterior margin of clypeus (Figure 73); one distinct waist segment ..... ***Nothomyrmeci***a

   Mandibles elongate and narrow, curved, with several larger teeth, and one or two smaller teeth in between each of these, mandibular dentition may be reduced towards base of mandible; eyes abutting posterior margin of head capsule (Figure 74); two distinct waist segments.....***Myrmeci***a

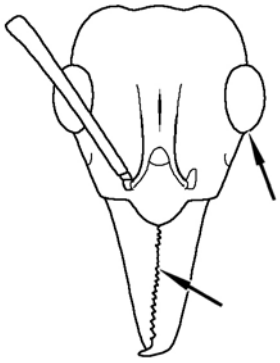

Figure 73

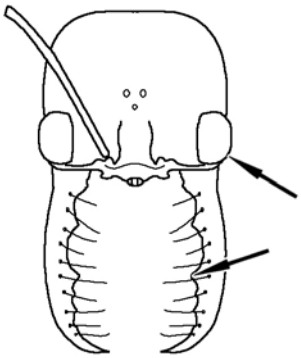

Figure 74

(d) Cerapachyinae

1. Abdominal segments III-VII with divisions smoothly joined, so that the outline is even (Figure 75) .....***Cerapachys***

   Abdominal segments III-VII with distinct constrictions between divisions so as to present an uneven outline (Figure 76) ....***Sphinctomyrmex***

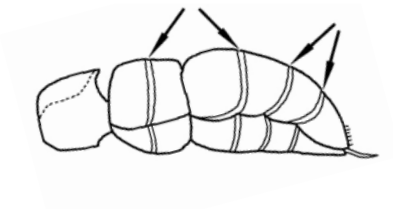

Figure 75

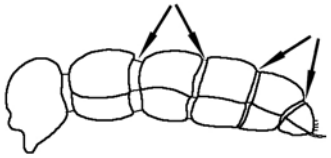

Figure 76

(e) Ponerinae;

1. Mandibles long and linear, inserted in central anterior margin of head (Figure 77)..... **2**

   Mandibles triangular or elongate, curved, inserted at sides of head (Figures 78)..... **3**

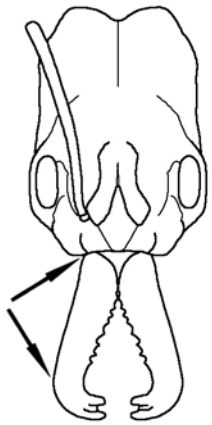

Figure 77

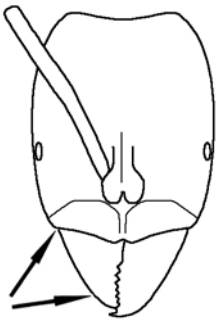

Figure 78

2. Top of head with V-shaped lines converging to form a groove on upper front of head (Figure 79) .....***Odontomachus***

   Top of head without V-shaped lines and with broad uninterrupted curved ridge; weak groove present or absent (Figure 80)..... .....***Anochetus***

Figure 79

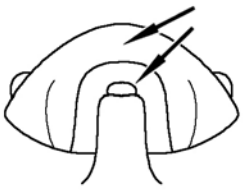

Figure 80

3. Mandibles elongate, curved (Figure 81) **4**

   Mandibles triangular (Figure 82) **5**

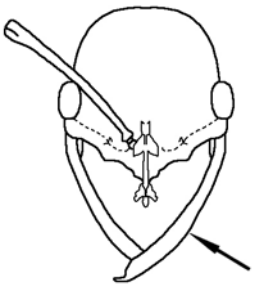

Figure 81

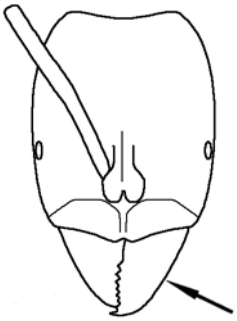

Figure 82

4. Pretarsal claws of hind leg equipped with one or more teeth on inner curvature (Figure 83), and usually pectinate ..... ***Leptogenys*** **(pt)**

   Pretarsal claws of hind leg simple (Figure 84) ..... ***Myopias***

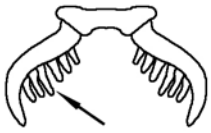

Figure 83

Figure 84

5. Tibia of hind leg with two distinctly pectinate spurs at or near its base (Figure 85a); clypeus broadly inserted between frontal lobes (Figure 85b) ..... ***Platythyrea***

   Tibia of hind leg with a single pectinate spur at or near its base (Figure 86), a simple spur may also be present; clypeus narrowly inserted between frontal lobes as a slender triangle or linear, indented strip (Figure 87) 6

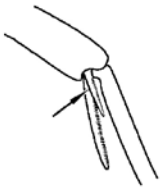

Figure 85a

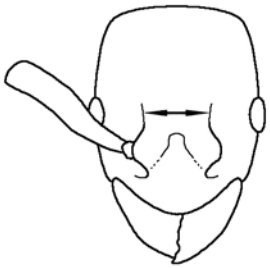

Figure 85b

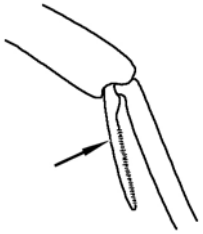

Figure 86

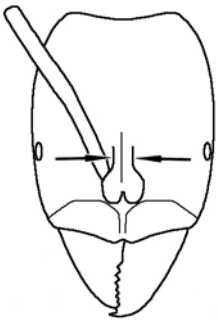

Figure 87

6. Pretarsal claws of hind leg equipped with one or more teeth on the inner curvature and usually pectinate (Figure 83); clypeus produced anteriad as an acute V-shaped projection (Figure 88) ..... ***Leptogenys* (pt.)**

   Pretarsal claws of hind leg simple (Figure 84); clypeus straight or broadly convex; not produced anteriad as an acute V-shaped projection (Figure 89) **7**

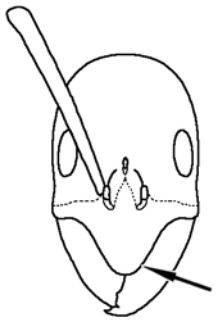

Figure 88

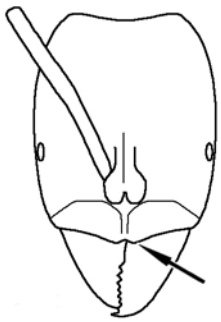

Figure 89

7. Tibia of hind leg with both a single large pectinate spur and a smaller simple spur (Figure 85a) ..... ***Pachycondyla***

   Tibia of hind leg with a single large pectinate spur (Figure 86) **8**

8. PF2,2; anteroventral process of petiole simple, without thin, circular translucent area anteriad (Figure 90) ..... ***Hypoponera***

   PF1,2 or 1,1; anteroventral process of petiole with thin, circular translucent area anteriad (Figure 91) ..... ***Ponera***

Figure 90

Figure 91

(f) Myrmicinae:

1. Distinctive ants with triangular, deeply emarginate heads (e.g. Figures 92, 94, 95); antennal segments (including the scape) less than nine; mandibles usually elongate, sometimes tongs-like..... **2**

   Ants not as above, heads more rounded (Figure 93); antennal segments nine or more; mandibles triangular..... **6**

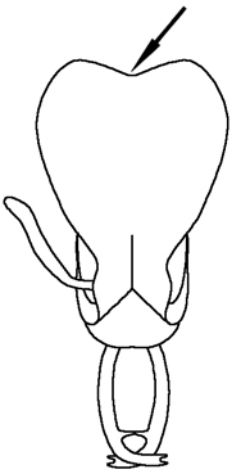

Figure 92

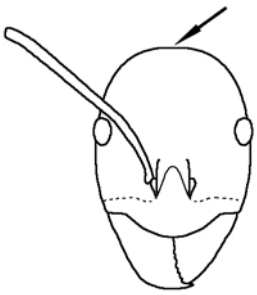

Figure 93

2. Mandibles long and thin, meeting only at the tips (Figure 94)..... 3

   Mandibles more elongate-triangular in shape, meeting along their entire length (Figure 95) **5**

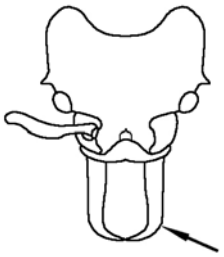

Figure 94

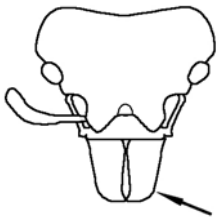

Figure 95

3. Antennal scape at rest passing below the eye (Figure 96a); head capsule about as long as wide (Figure 96b); nodes without foam-like material around them ..... ***Epopostruma***

   Antennal scape at rest passing above the eye (Figure 97); head capsule much longer than wide (Figure 98); nodes may have foam-like cuticular material attached..... 4

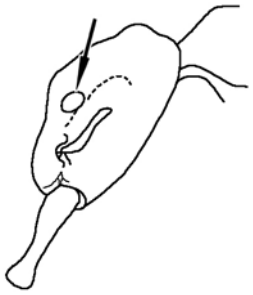

Figure 96a

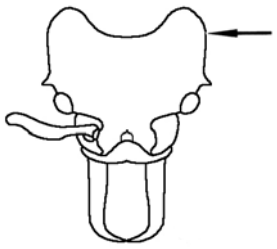

Figure 96b

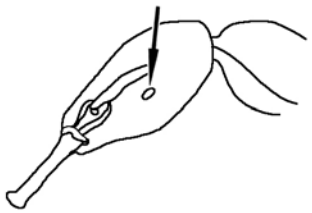

Figure 97

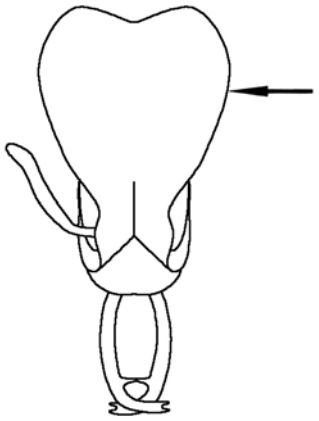

Figure 98

4. Antenna with five segments, the third segment being longer than the other three segments of the flagellum (Figure 99); PF 5,3; waist segments without foam-like cuticular material attached (SW, one rare species) .... ***Orectognathus***

   Antenna with four or six segments (Figure 100); third segment at most the same length as the other segments; PF 1,1; waist segments often with foam-like material attached .... ***Strumigenys***

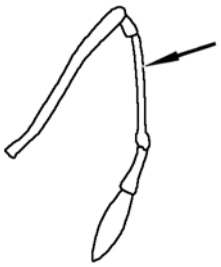

Figure 99

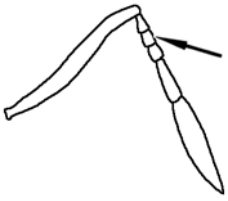

Figure 100

5. Lateral margins of both petiole and postpetiole with thin, wing-like flanges (Figure 101) .... ***Colobostruma***

Wing-like flanges found only on postpetiole (petiole has at most a slight ridge) (Figure 102) ..... ***Mesostruma***

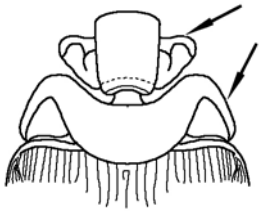

Figure 101

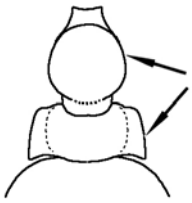

Figure 102

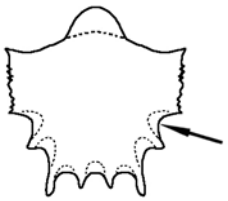

Figure 103

6. Antenna with nine segments; dorsum of anterior mesosoma flattened and projecting to form a shield, often with regular protruding edges and translucent 'windows' between these edges (Figure 103) ..... ***Meranoplus***

   Antenna with 10 or more segments; dorsum of mesosoma never forming a shield as above **7**

7. Postpetiole attached to upper surface of gaster, which is heart-shaped when seen from above; petiole flattened; viewed from above, postpetiole often distinctly bilobed (Figure 104) ..... ***Crematogaster***

   Postpetiole attached to the front of the gaster, which is not distinctly heart-shaped; petiole usually with a node, not flattened (Figure 105); postpetiole not bilobed as above **8**

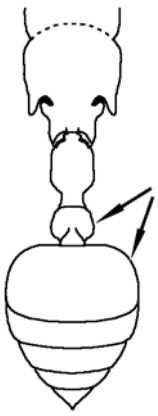

Figure 104

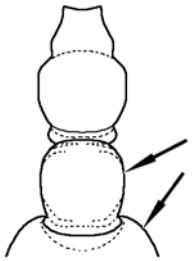

Figure 105

8. Eyes absent or (rarely) single faceted (Figure 106); antennal club 3-segmented ..... ***Monomorium* (pt.)**

   Eyes usually present, though may be small (Figure 107); if minute or absent (in some specimens of *Solenopsis belisarius*), then antennal club 2-segmented..... **9**

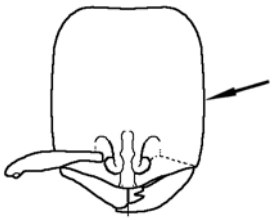

Figure 106

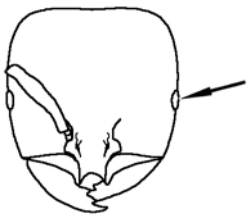

Figure 107

9. Viewed from front, area of clypeus below antennal sockets raised into a sharp ridge (Figure 108a); tip of sting with a triangular or club-like appendage projecting upwards from the shaft (Figure 108b); propodeal angle usually a pair of stout spines, sometimes flanges ..... ***Tetramorium***

   Viewed from front, area of clypeus below antennal sockets smooth or a dull ridge (Figure 109); tip of sting usually thin and pointed, occasionally slightly flattened, but without appendage (Figure 110); propodeal angle often absent or with pair of protuberances only..... **10**

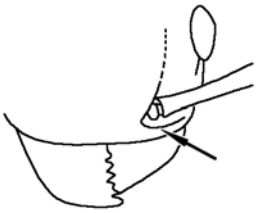

Figure 108a

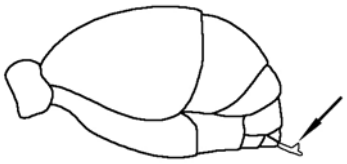

Figure 108b

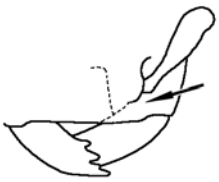

Figure 109

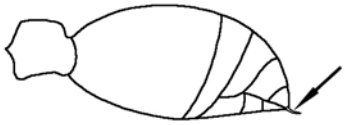

Figure 110

10. First and second antennal segments much longer than remaining segments and forming a distinct two-segmented club (Figure 111) **11**

    Antenna either without a club (Figure 112) or with a club of three or more segments (Figure 113)..... **13**

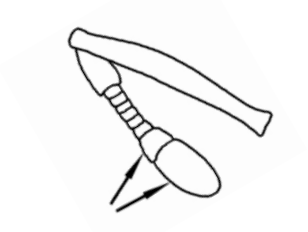

Figure 111

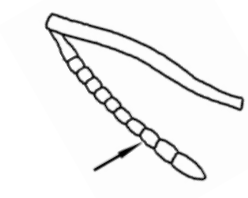

Figure 112

Figure 113

11. Deep, elongate antennal scrobes present, able to accommodate entire antenna; eyes elongate, with lower sector oblique and narrow (Figure 114)..... ***Mayriella***

    Antennal scrobes absent; eyes small and round (Figure 115) or vestigial..... **12**

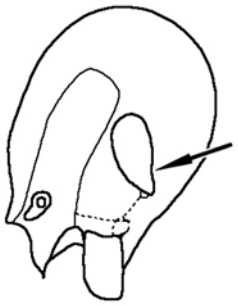

Figure 114

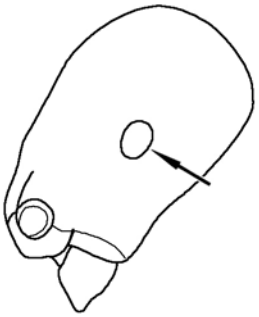

Figure 115

12. Rear face of propodeum rounded, never with teeth, spines or flanges (Figure 116a); midpoint of anterior clypeal margin with a single seta, often surrounded by paired setae (Figure 116b); WA species monomorphic or weakly polymorphic..... ***Solenopsis***

    Rear face of propodeum with spines, teeth or flanges (Figure 117a); clypeus with a pair of setae that straddle the midpoint of the anterior clypeal margin (Figure 117b); strongly dimorphic, major workers with a pair of short horns on the vertex of the head capsule in some Eastern states species (major of SWBP species not known) ..... ***Carebara***

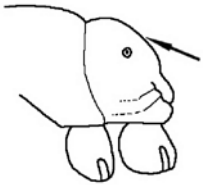

Figure 116a

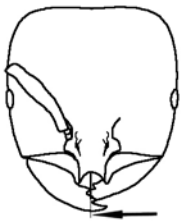

Figure 116b

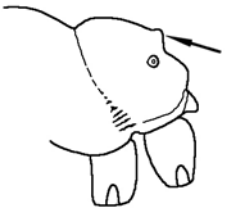

Figure 117a

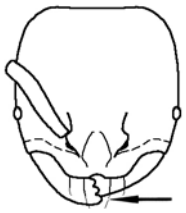

Figure 117 b

13. Antennal segments 10..... ..... ***Monomorium*** **(pt.)**

    Antennal segments 11 or 12. ..... **14**

14. Antennal segments 11. ..... **15**

    Antennal segments 12. ..... **17**

15. Femora and often tibiae of middle and hind legs greatly swollen; petiole round in cross-section, long and low, usually with a pair of short spines or teeth or acuminate (Figure 118); arboreal ants..... ..... ***Podomyrma***

    Femora and tibiae not or only weakly swollen; petiole short or long with a node, but without processes (e.g. Figure 119); species wholly (e.g. *Adlerzia*) or predominantly (e.g. *Monomorium*) terrestrial..... **16**

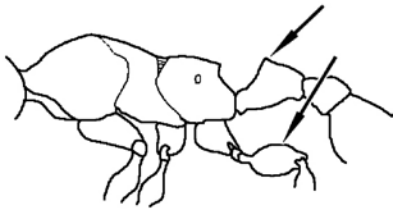

Figure 118

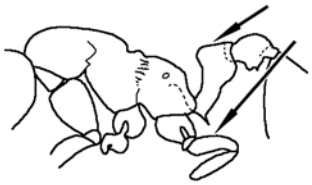

Figure 119

16. Central anterior margin of clypeus with a pair of setae surrounded by other setae (Figures 120a and 120b); major and minor workers (i.e. dimorphic worker caste) (Note: Also look for circular striations on the promesonotum.) .... ***Adlerzia***

    Central anterior margin of clypeus with single seta, which is surrounded by paired setae (Figure 121); single worker caste only (i.e. monomorphic) ..... ***Monomorium*** **(pt.)**

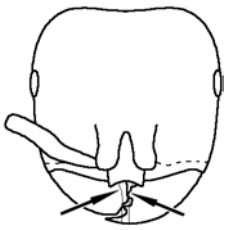

Figure 120a

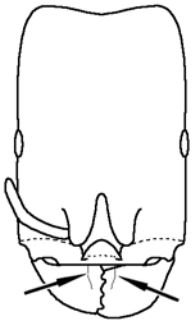

Figure 120b

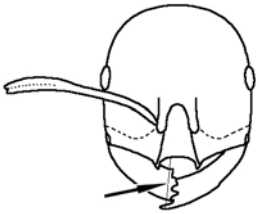

Figure 121

17. Central anterior margin of clypeus with single seta, which is surrounded by paired setae **18**

    Central anterior margin of clypeus with pair of setae, or with numerous setae or lacking setae **19**

18. Maxillary palp (outer palp) five segmented; clypeus not bicarinate; postpetiole (seen from above) much more massive than petiole (Figure 122) ..... ***Cardiocondyla***

    Maxillary palp with one or two segments; clypeus often bicarinate with the central clypeal region depressed; viewed from above the postpetiole usually smaller or the same size as the postpetiole (Figure 123) ..... ***Monomorium* (pt.)**

Figure 122

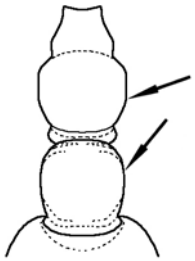

Figure 123

19. Antenna with loose, four-segmented club (Figure 124); monomorphic (medium-sized yellow or orange ants that have a which have a distinctive nest formed of a deep, wide tunnel surrounded by a pile of loose dirt.) ..... ***Aphaenogaster***

    Antennal club three-segmented (Figure 125); Rogeria is monomorphic, the other genera are dimorphic (Pheidole) or polymorphic (Anisopheidole) **20**

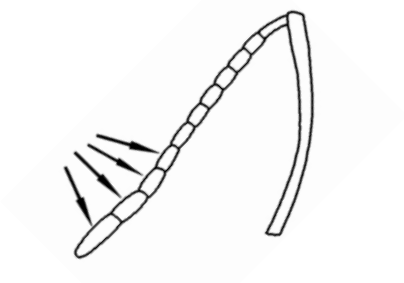

Figure 124

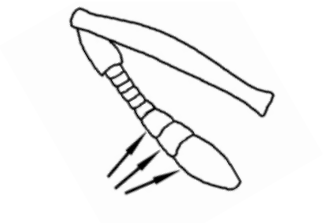

Figure 125

20. In lateral view promesonotum steeply sloping down to the propodeum; dimorphic (Figure 126) ..... ***Pheidole***

    In lateral view all segments of mesosoma more-or-less on the same plane, interrupted only by the shallow metanotal groove; monomorphic or polymorphic (Figure 127) **21**

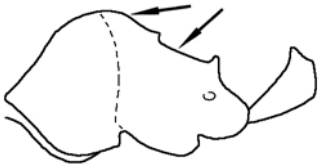

Figure 126

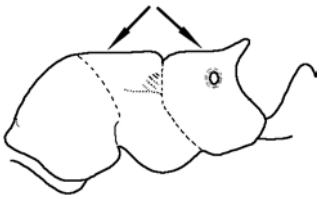

Figure 127

21. Eyes minute (four facets wide at widest point) (Figure 128); polymorphic..... ***Anisopheidole***

    Eyes moderate (at least eight facets wide at widest point) (Figure 129); monomorphic ..... ***Rogeria***

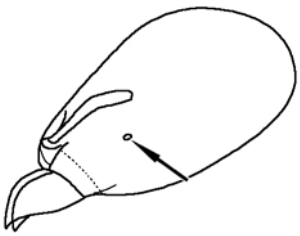

Figure 128

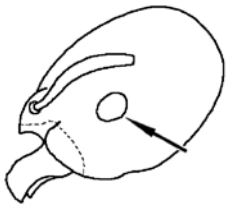

Figure 129

KEY TO THE ANT SPECIES OF THE SOUTH-WEST BOTANICAL PROVINCE

As far as is currently known, the two subfamilies Pseudomyrmecinae and Leptanillinae are represented by only one genus and one species in the SWBP. Sixteen genera in the subfamilies Dolichoderinae, Formicinae, Myrmeciinae, Ponerinae and Myrmicinae are also represented by just one species in the SWBP. In the case of the above, keying out the genus - or subfamily, in the case of the Pseudomyrmecinae and Leptanillinae - will also provide the species name (i.e. if the ant has been described). The taxa believed to be monotypic for the SWBP are as follows:

Dolichoderinae:

Linepithema - Linepithema humile (Mayr)

Nebothriomyrmex - Nebothriomyrmex majeri Dubovikov

Technomyrmex - Technomyrmex jocosus Forel

Formicinae:

Myrmecorhynchus -Myrmecorhynchus emeryi André

Opisthopsis - Opisthopsis rufithorax Emery

Myrmeciinae:

Nothomyrmecia - Nothomyrmecia macrops Clark

Pseudomyrmecinae:

Tetraponera - Tetraponera punctulata Smith

Leptanillinae:

Leptanilla - Leptanilla swani Wheeler

Ponerinae:

Anochetus - Anochetus armstrongi McAreavey

Myopias - Myopias tasmaniensis Wheeler

Odontomachus - Odontomachus ruficeps Smith

Ponera – Ponera sp. JDM 1122

Myrmicinae:

Adlerzia - Adlerzia froggatti (Forel)

Anisopheidole - Anisopheidole antipodum (F. Smith)

Cardiocondyla - Cardiocondyla 'nuda' (Mayr) (possibly two closely-related species)

Carebara - Carebara sp. JDM 440

Mayriella - Mayriella occidua Shattuck

Orectognathus - Orectognathus clarki Brown

The species-level key provided below covers the remaining 45 ant genera represented in the SWBP. *Caution:* the species level key is comprehensive only for the species known by the author to exist in the SWBP. It is completely possible, indeed likely, that holdings in institutions other than the Curtin Ant Collection may contain additional species. Continuing collecting efforts may also uncover new, unknown species as well as those known previously only from areas outside of the SWBP. However, the discovery of additional genera is far less likely. *(n.b. Within the key, the specification 'erect setae absent from antennal scape' or 'erect setae absent from femora' excludes those setae that are nearly always present at the extreme distal end of those structures.)*

A NOTE ON TAXONOMIC DECISIONS MADE IN THIS WORK

I have here made a taxonomic decision on eight species mentioned in this work, i.e. *Doleromyrma rottnestensis* (Wheeler) (formerly *Tapinoma rottnestense* Wheeler), *Iridomyrmex argutus* Shattuck, *Iridomyrmex innocens* Forel, *Iridomyrmex occiduus* Shattuck, *Pachycondyla* (*Trachymesopus*) *clarki* Wheeler, *Pachycondyla* (*Trachymesopus*) *rufonigra* Clark, *Crematogaster frivola* (Forel) and *Crematogaster perthensis* Crawley. In a number of other cases I have suggested likely synonymy, based on a cursory examination or textual indicators, but this needs to be confirmed by a more rigorous analysis, hence should not be taken as definitive. The position of *Rogeria* is also provisional: the two species here placed under that head might still require the erection of a new genus.

SPECIES KEY AND DISCUSSION OF SPECIES

SUBFAMILY DOLICHODERINAE

The dolichoderine ants include some of the best-known ants in Australia. Several of the meat ants (which include at least a dozen species) are synonymous with rural Australia. The native odorous ant, *Iridomyrmex chasei* Forel, is ubiquitous on pavements and in backyards in Perth. However, in some other capital cities, other members of the *Iridomyrmex rufoniger* species-group rival it in importance. A nominate subspecies of *I. chasei*, *Iridomyrmex chasei concolor* Forel, swarms in all degraded sites in drier woodlands and pastures. In general, the large number of *Iridomyrmex* species found in temperate Australia, and their dominance where they occur, attest to the success of the genus in colonizing this country (Greenslade 1979). This subfamily also includes notorious pests such as the Argentine Ant, the ghost ant and the white-footed house ant, the first two of which can be found in Perth. Members of this subfamily are the only ants with a slit-like opening on the tip of the gaster, from which they can release a cocktail of chemicals for various purposes, including offence and defence.

Anonychomyrma

1. In full-face view, head capsule about as long as wide, vertex shallowly concave (Figure 130); small setae constituting pubescence almost semi-erect; mesonotum not prominent (terrestrial)..... ***A. itinerans perthensis*** **(Forel)**

   In full-face view, if head capsule as long as wide, then vertex deeply concave (Figures 131, 132); small setae constituting pubescence appressed or weakly decumbent; mesonotum often prominent (arboreal) **2**

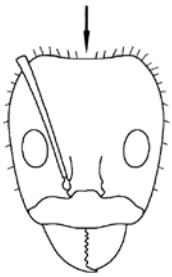

Figure 130

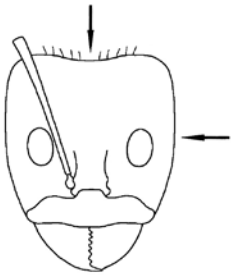

Figure 131

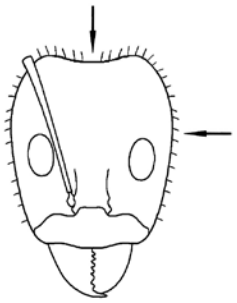

Figure 132

2. Erect setae absent from sides of head capsule; vertex deeply concave; head capsule as long as wide (Figure 131); mandibles usually brown or orange, contrasting with darker head..... ..... ***A. nitidiceps*** **(André)**

   Erect setae present on sides of head capsule; vertex shallowly concave; head capsule distinctly longer than wide; mandibles often black or dark brown, concolorous with head (Figure 132)..... .....***Anonychomyrma*** **sp. JDM 835**

These ants are readily recognizable, not so much because of their appearance as by the acrid smell they release when disturbed. *Anonychomyrma* species are mainly shiny, black ants that were formerly included in *Iridomyrmex*. Shattuck (1992a,b) removed them from *Iridomyrmex* on the basis of features of their clypeus, deeply concave head and placement of the compound eyes. For the most part they are arboreal foragers for dead or live prey, but will collect plant juices and may be associated with caterpillars (Shattuck 1999). However, one species in the SWBP is a terrestrial nester, and is rarely found on trees.

Anonychomyrma nitidiceps (André) is a large-headed arboreal species with a dome-shaped mesonotum, which also forages on the ground near standing trees or fallen wood. If disturbed, this species emits an odour plume that can easily be detected several metres away. *Anonychomyrma nitidiceps* is found in a range of woodland types in the south-west and south of the State. *Anonychomyrma* sp. JDM 835 is another arboreal form that can be distinguished from the above species by slight but consistent characters of pilosity, head shape and, often, colour of the mandibles. This ant has mostly been collected from near Perth. Workers of *Anonychomyrma itinerans perthensis* (Forel) are distinguished from the other two species by their more shallowly concave vertex, erect pubescence and non-prominent mesonotum. The turret nests of *A. itinerans perthensis* are one of the most characteristic sights on sandy soils in the Perth region. The smooth, shiny *A. itinerans*

perthensis workers will often be seen moving slowly and deliberately in and out of these nests. This species prefers wetter areas in the south-west of the State.

Arnoldius

Arnoldius scissor (Crawley) was described from a queen, and so the taxon is not formally recognized in this key to workers.

1. Eye larger, eye width > greatest width of antennal scape; brown species..... ..... ***Arnoldius* sp. JDM 433**

   Eye smaller, eye width ≤ greatest width of antennal scape; yellowish species ....***Arnoldius* sp. JDM 170**

Their short palps (PF 2,2), small compound eyes and the presence of downwardly curved clypeal setae easily identify these small, cryptic ants. The genus was recently split from the Holarctic and Oriental genus *Bothriomyrmex* by Dubovikov (2004) on the basis of its low PF count and features of the reproductive wing veins. Workers in the SWBP have mostly been found in heavy litter, and in rotten wood. One of the local species is most probably a social parasite of *Iridomyrmex*, and temporary social parasitism is definitely known for overseas species (Santschi 1906; Donisthorpe 1944).

Neither of the two described SWBP species can currently be identified with certainty from material held in the Curtin Ant Collection, but judging from the description in Crawley (1922) the small, yellow *Arnoldius* sp. JDM 170 is most probably identical with *Arnoldius flavus* (Crawley). This ant has been found in Jarrah-Marri woodlands south of Perth to as far north as the Zuytdorp region, north of Kalbarri. *Arnoldius scissor* (Crawley) was described from two queens by Crawley (1922). The peculiar character of the queen mandible (with its reduced dentition and sharp, curved, concave inner edge) strongly supports the notion that the queen is a social parasite. The queens were collected from a colony of *Iridomyrmex innocens* Forel, and Crawley was of the opinion that this species was parasitic on *I. innocens*. The relatively large, brownish *Arnoldius* sp. JDM 433 has a known range in the SW corner of the State, and also SE to Jerramungup, but it may well extend eastward in suitable habitat to at least the Esperance region. What appears to be the same species has also been recorded from Barrow Island, off the Pilbara coast and from the Pilbara region itself.

Doleromyrma

1. Node prominent, rising well above the articulation of the peduncle with the propodeum (Figure 133a); in full-face view head usually not distinctly rectangular, without evenly convex sides above and below midpoint of head (Figure 133b)..... ..... ***Doleromyrma darwiniana fida* (Forel)**

   Node indistinct, *Tapinoma*-like, barely rising above the articulation of the peduncle with the propodeum (Figure 134a); in full-face view, head typically strongly rectangular, the sides of the head evenly convex above and below the midpoint (Figure 134b)..... .....***Doleromyrma rottnestensis* (Wheeler)**

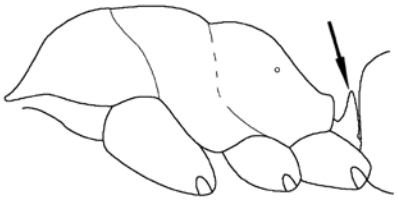

Figure 133a

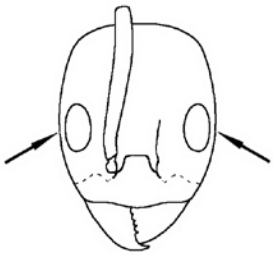

Figure 133b

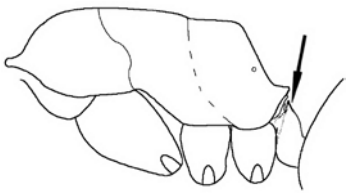

Figure 134a

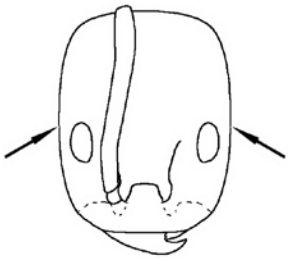

Figure 134b

The standard separation of *Doleromyrma* from *Tapinoma* based on the presence or absence of a scale-like node does not work very well for species of both genera in the SWBP. *Doleromyrma* populations from the Darling Range and from near the south coast are larger ants with a small but distinct node. However, *Doleromyrma* populations

from the Swan coastal plain and the edge of the Darling scarp tend to be smaller. These workers often have a node so reduced that it is no more than an oblique fracture in the petiolar peduncle. The clypeus in local *Tapinoma* and *Doleromyrma* includes both straight and downwardly directed setae, and the mandibular angle is only worthwhile as a character if the mandibles are agape. Moreover, the diagnostic curve of the setae in *Doleromyrma* is distinct only in larger specimens. Whereas Shattuck (1999) also states that the number of teeth in *Doleromyrma* is fewer than in *Tapinoma*, in the case of the SWBP fauna, the situation is reversed! In fact, the most common local *Tapinoma* species usually has three distinct teeth, i.e. the apical tooth and two preapical teeth, while the remainder are lacking or reduced to indistinct serrations. On the other hand, *Doleromyrma* have distinct teeth along the masticatory margin of the mandible. Local *Doleromyrma* species can also be recognized by their uniformly brown appearance (local *Tapinoma* are either yellow, or brown with light ochre mesonotum and appendages). The head tends to be broader in *Tapinoma*, and the peduncle of the petiole is longer and has no hint of a node.

In seeking for a reliable character to distinguish *Doleromyrma* from *Tapinoma*, I examined the posterior margin of the clypeus between the frontal carinae. I found that, whereas the posterior margin was a broad, even arc in fifteen *Tapinoma* species examined (as pinned material or as images on http://www.antweb.org/)[1], this margin was a narrower ellipse and more-or-less straight posteromedially in WA species (three) identified as *Doleromyrma*. This character may have universal applicability, and is being investigated by Dr. Steve Shattuck (ANIC).

Based on comparison with syntypes held at the ANIC (*Doleromyrma darwiniana fida* (Forel) and likely syntypes held at the Western Australian Museum (WAM) (*Tapinoma rottnestense* Wheeler), I believe there are at least two species of *Doleromyrma* in the SWBP. *Doleromyrma darwiniana fida* is unproblematic, since it possesses an obvious node plus the other features associated with the genus. However, *Tapinoma rottnestense* is, in my opinion, a *Doleromyrma*, despite the vestigial node. The petiole of this species is short, like that of *D. darwiniana fida*, the mandible is oblique but with just 5 distinct teeth and several tiny denticles, and the clypeal setae are long, reaching almost to the base of the closed mandibles. The habitus, on the other hand, and particularly the appearance of the head capsule, is very similar to that of *Tapinoma*. However, the posterior margin of the clypeus between the frontal carinae is a narrow ellipse that is straight posteromedially, typical of *Doleromyrma* as discussed above. In this work, this species is placed under *Doleromyrma*, despite the difficulties posed by its very *Tapinoma*-like morphology. ***Doleromyrma rottnestensis* (Wheeler) comb. nov.** is therefore recognized here.

These ants are a common, if inconspicuous part, of the fauna in wetter parts of the SWBP, and also occur in Perth suburban gardens. They can be found directly nesting into soil or under stones or logs, or (in the case of metropolitan populations) discarded debris. In NSW, *Doleromyrma* is an occasional pest in houses (Nitikin 1979), but has never come under adverse notice in WA (P. Davis, Agriculture Department of WA, pers. comm.).

Dolichoderus

1. Propodeum armed with a pair of sharp spines (*ypsilon* group) **2**

   Propodeum unarmed **5**

2. Femur, tibia and tarsi light red or orange..... ..... **3**

   Femur, tibia and tarsi dark reddish-brown or black **4**

3. Viewed from front, propodeum spines directed upward at angle of greater than 60° to horizontal plane (may be almost vertical) (Figure 135) ..... ***D. angusticornis* Clark**

   Viewed from front, propodeal spines directed upward at angle of 45° or less to horizontal plane (Figure 136)..... ..... ***D. ypsilon* Forel**

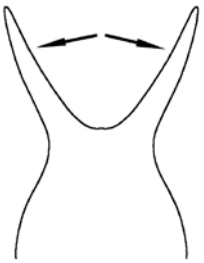

Figure 135

Figure 136

[1] The species viewed were *Tapinoma ambiguum* Emery, *T. annandalei* Wheeler, *T. erraticum* Latreille, *T. fragile* F. Smith, *T. litorale* Wheeler (*sensu lato*), *T.* '*mad*04', *T. pallipes* F. Smith, *T. pomone* Donisthorpe, *T. sessile* Say, *T. subtile* Santschi, and *T. williamsi* Wheeler. Examined as pinned specimens were *T. melanocephalum* Fabricus, vouchers of WA species '*Tapinoma* sp. JDM 78' and '*Tapinoma* sp. JDM 918' and a *Tapinoma* sp. indet. from Queensland.

4. Femur, tibia and tarsi black; pubescence on gaster off-white..... ..... ***D. ypsilon nigra*** **Crawley**

   Femur, tibia and tarsi dark reddish-brown; pubescence on gaster yellow..... .....***D. ypsilon rufotibialis*** **Clark**

5. Declivitous face of propodeum straight (Figure 137); head smooth and shining..... .....***D. glauerti*** **Wheeler**

   Declivitous face of propodeum weakly to strongly concave (Figure 138); head with distinct sculpture..... **6**

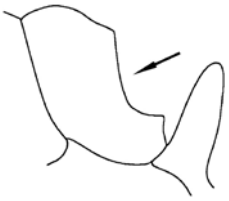

Figure 137

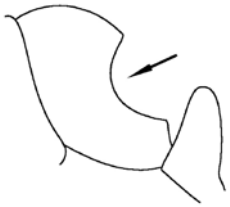

Figure 138

6. Pronotal sculpture weakly rugose-punctate, or sculpture largely lacking (Figure 139)..... ..... **7**

   Pronotal sculpture distinctly foveate-reticulate (Figure 140)..... **9**

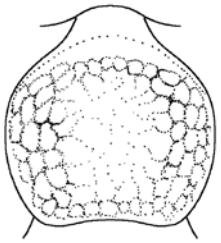

Figure 139

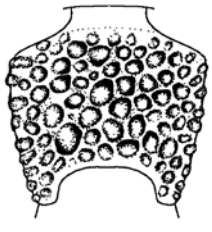

Figure 140

7. Standing setae on head, antennal scapes, mesosoma and gaster sparse and short (≤ greatest width of antennal scape), sparse or absent on tibiae; usually pale, depigmented.... ..... ***Dolichoderus*** **sp. JDM 1106**

   Standing setae on head, antennal scapes, mesosoma and gaster abundant and longer (longest setae >> greatest width of antennal scape), present on tibiae; body bicoloured (mesosoma orange to yellowish-brown, gaster and often head brown);..... **8**

8. Dorsum of propodeum strongly convex, carina separating dorsal and declivitous faces of propodeum not produced as a sharp shelf (Figure 141); without pale markings near lower margin of eyes; sculpture of pronotum almost lacking, pronotum shining..... ..... ***D. clusor*** **Forel**

   Dorsum of propodeum weakly convex, carina separating dorsal and declivitous faces of propodeum produced as sharp shelf (Figure 142); pale markings present near lower margin of eye; sculpture of pronotum weakly rugose-punctate..... ..... ***Dolichoderus*** **sp. JDM 513**

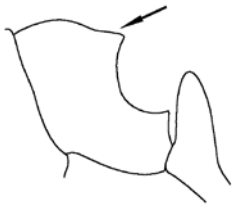

Figure 141

Figure 142

9. Propodeal dorsum not evenly convex, declivitous face very deeply concave, concavity almost semi-circular (Figure 143)..... ..... ***D. reflexus*** **Clark**

   Propodeal dorsum evenly convex, declivitous face less deeply concave, concavity much less than a semi-circle in extent (Figure 144)..... ..... **10**

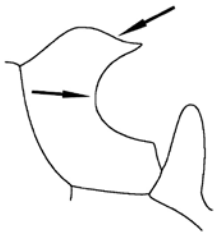

Figure 143

Figure 144

10. Antenna much darker than head..... ..... ***D. nigricornis*** **Clark**

Antenna the same colour, or slightly lighter in colour than head **11**

11. Mesosoma light to medium reddish-brown; head, gaster, nodes and appendages varying from brown to reddish-orange ....***D. formosus*** **Clark**

Body and appendages blackish..... ..... ***D. occidentalis*** **Clark**

Dolichoderus species are recognized by the presence of a flange on the underside of the head, near the base of the mandible. Members of this genus are most attractive ants: in the subgenus *Diceratoclinea*, which is armed with long propodeal spines, the appearance of the head capsule with its foveate hair-pits, when viewed under a dissecting microscope, is reminiscent of a shiny, black golf-ball. In subgenus *Hypoclinea* the propodeum is concave, a feature otherwise seen among Australian Dolichoderinae only in *Ochetellus*. Two other Australian subgenera do not occur in the SWBP. Most species of *Dolichoderus* also have a highly sculptured and well sclerotized exoskeleton, a rarity among dolichoderine ants. Workers of SWBP species are often seen in woodland, where they can be found foraging on tree-trunks, on vegetation, or on the ground. They also tend Hemiptera (Shattuck 1999).

Dolichoderus is diverse in the SWBP, and the Province boasts 10 described species (along with two undescribed taxa) compared with a described Australian fauna of 22 species. They are particularly abundant in Banksia woodlands north and south of Perth. Of the *Dolichoderus ypsilon* radiation, the red-legged, black *D. ypsilon* Forel, itself, is the best-known form in the Perth region. In workers of this species, the propodeal spines form a wide 'V' when seen from behind. In the closely related *Dolichoderus angusticornis* Clark, the propodeal spines are more-or-less parallel when seen from behind. This ant is found in drier areas in the eastern and southern wheatbelt. *Dolichoderus ypsilon rufotibialis* Clark, from the south coast, has reddish-brown rather than red legs. The large and handsome *Dolichoderus ypsilon nigra* is all black, unlike the preceding species. Also unlike them, this species has whitish instead of yellowish pubescence on the gaster. This is another species whose main distribution covers the wetter areas of the south-west corner of the State. *Dolichoderus ypsilon nigra* is also found in relictual native woodland in the Perth metropolitan area.

Ants in the subgenus *Hypoclinea* are less numerous than those in *Diceratoclinea*. Several of the described taxa (i.e. *Dolichoderus clusor* Forel, *Dolichoderus formosus* Clark and *Dolichoderus occidentalis* Clark) can be separated only by examining relatively minor differences in sculpture or colour, and may actually be conspecific. *Dolichoderus clusor* Forel is perhaps the commonest of these, and is found mainly in Banksia woodland in the Perth area, but has also been recorded in the western goldfields at Westonia. *Dolichoderus* sp. JDM 513 is a similar species, but with a pronounced propodeal shelf. This ant has a wide range throughout the SWBP. *Dolichoderus nigricornis* Clark is a dark orange-and-black species found in the eastern wheatbelt. The pale *Dolichoderus* sp. JDM 1106 differs from all of the preceding forms in being relatively much less hirsute, standing setae being absent from the tibiae in most workers seen, apart from a few bristly setae near the apex. However, more specimens of this ant, which is known in the SWBP from a small number of workers from Eneabba, are needed. The sombre-coloured *Dolichoderus occidentalis*, Clark, found on and near the south coast, differs mainly in colour from *Dolichoderus formosus* Clark, the typical form of which has a dark brown or blackish head and gaster and a reddish-brown mesosoma. The distinction between these two species may be dubious, as *D. formosus* appears to be colour variable: while the typical form of *D. formosus* has been collected around Perth, elsewhere, especially in drier areas, a *Dolichoderus* occurs that is usually either a concolorous bright orange or brownish-red with a light orange to dark orange-red gaster. Apart from the colour, this ant is identical with *D. formosus* and is here accepted as no more than a variation of the latter species.

Dolichoderus reflexus Clark, known to the Curtin Ant Collection from two records from Eneabba, has an exaggerated propodeal concavity. The ant was described from specimens taken at several localities on the Fleurieu Peninsula, SA. In *Dolichoderus glauerti* Wheeler, the propodeum lacks a distinct

concavity and is dorsally rounded. This ant has a sparse distribution through the south-west and into the eastern goldfields.

Froggattella

1. Viewed dorsally, propodeal spines thick, laterally convex, not distally digitate (Figure 145); in full-face view, head capsule noticeably longitudinally striate between and around frontal carinae, smooth and shining posteriad .....***F. latispina* Wheeler**

   Viewed dorsally, propodeal spines tending to straight distally, digitate in appearance (Figure 146); in full-face view, head capsule uniformly weakly shining, with superficial micoreticulation evident in some lights ....***F. kirbii* (Lowne)**

Figure 145

Figure 146

The horizontally directed propodeal spines separate this genus from other dolichoderines. The common species found in the SWBP, *Froggattella kirbii* (Lowne), avoids the wetter south-west corner, but is not uncommon in the wheatbelt and in mallee country in the south-east of the SWBP. Workers can be seen trailing on low mallees or on the ground, and evade capture by hiding under bark. This ant has a wide distribution throughout open woodland areas in Australia (Shattuck 1999). A second species has recently been collected in a student project near Lake Warden, close to the Esperance townsite. The two workers taken are very small, reddish-brown, and about half the size of a typical *F. kirbii* worker. Apart from their small size, however, the workers have all the diagnostic characters of *Froggattella latispina* Wheeler, and are tentatively placed in that taxon (type material overseas has not yet been sighted).

Iridomyrmex

Keys to the *I. calvus* species-group have been adapted from Shattuck 1993(b), the *I. conifer* species-group from Shattuck and McMillan 1998, and the *I. purpureus* species-group from Shattuck 1993(a).

1. Propodeum large, conical (*I. conifer* species-group) (Figure 147)..... **2**

   Propodeum smaller, not conical (Figure 148)..... ..... **4**

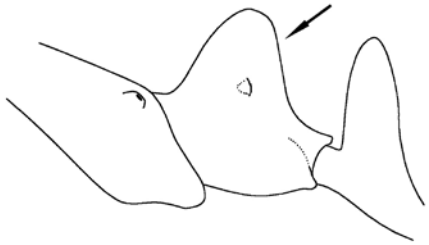

Figure 147

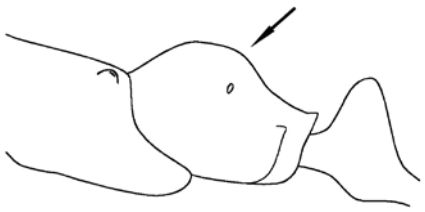

Figure 148

2. Erect or suberect setae on pronotum usually lacking, but where present never more than 6. ..... ***I. conifer* Forel**

   More than 8 erect or suberect setae present on pronotum **3**

3. In full-face view, lateral margin of head generally lacking erect setae, but where present posterior setae larger than greatest diameter of scape, and distinctly curved..... .....***I. turbineus* Shattuck and McMillan**

   In full-face view, lateral margin of head always with numerous short, erect setae, these setae always less than maximum scape diameter, and straight or slightly curved .... ***I. setoconus* Shattuck and McMillan**

4. Large ants (HW > 1.5 mm); erect setae on all surfaces of tibiae and often of scapes; mesonotum with angle or arch between convex anterior sector and flat posterior sector (Figure 149); purple, green or blue iridescence present in SW species ("meat ants" in *I. purpureus* species-group)..... **5**

   Differing in one or more of the above characters (e.g. Figure 150)..... **8**

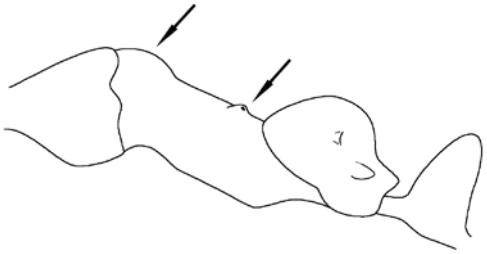

Figure 149

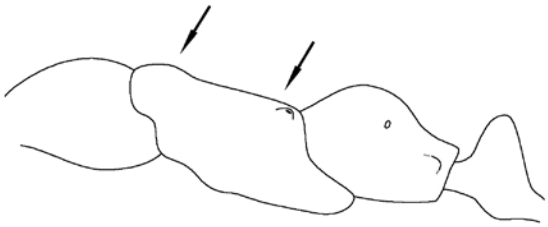

Figure 150

5. Lateral and/or dorsal regions of head with weak green iridescence (and often purple iridescence) ..... ***I. viridiaeneus* Viehmeyer**

Lateral and/or dorsal regions of head with purple or blue, but never green iridescence..... 6

6. In profile, posterior region of pronotum (immediately anterior of the promesonotal suture) rising above the mesonotum in a short, strongly convex arch (Figure 151); sides of head with only very weak purplish iridescence or with no iridescence ..... ***I. reburrus* Shattuck**

In profile, posterior region of pronotum (immediately anterior of the promesonotal suture) rising above the mesonotum in a broad, uniform, weakly convex arch (Figure 152); sides of head usually with well-developed iridescence (commonly purple or blue)..... **7**

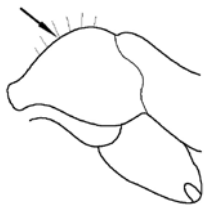

Figure 151

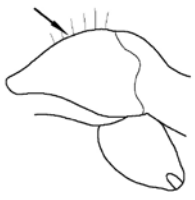

Figure 152

7. Head and mesosoma dark reddish-brown to black; head often with strong blue iridescence. ..... ***I. lividus* Shattuck**

Head and mesosoma reddish-brown; head with purple iridescence..... ***I. greensladei* Shattuck**

8. Frontal carinae of head capsule curved throughout their length (*I. calvus* species-group) (Figure 153)..... **9**

Frontal carinae of head capsule sinuate or approximately straight medially (Figure 154) **13**

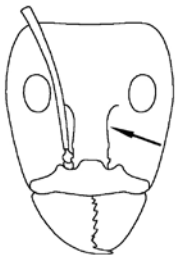

Figure 153

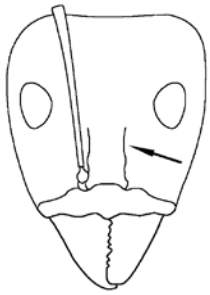

Figure 154

9. Propodeum flattened, with propodeal spiracles situated dorsally near propodeal angles; petiolar node very low and broad; body black, with blue iridescence (Figure 155)..... ***I. calvus group* sp. JDM 1069**

Propodeum more rounded, propodeal spiracle situated laterally; petiolar node more developed, narrow (e.g. Figure 156) **10**

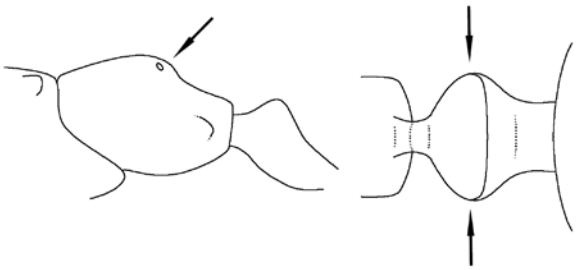

Figure 155

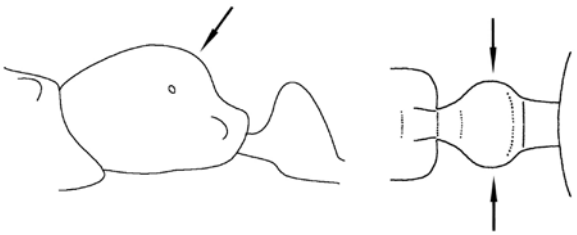

Figure 156

10. Tibiae devoid of erect setae **11**

    Tibiae with regularly placed erect setae **12**

11. Mesosoma with numerous short to medium-length (longest setae ≈ width of eye) erect setae .....***I. hesperus* Shattuck**

    Mesosoma often lacking erect setae, if present then confined to one or two pairs on pronotum and/or mesonotum, short (width of eye <).....***I. notialis* Shattuck**

12. Erect setae absent from antennal scape; head and mesosoma finely sculptured, the sculpture obscured by appressed pubescence ....***I. prismatis* Shattuck**

    Erect setae present on antennal scape; head and mesosoma shining and generally smooth, with only superficial microreticulation evident in some lights, the cuticle not obscured by appressed pubescence *I. innocens* Shattuck (including former *I. occiduus* and *I. argutus*).

13. Viewed from front, head capsule very long, up to twice as long as wide, its widest point well above its midpoint (Figure 157); vertex of head capsule often weakly to strongly convex; appendages long, femur and tibia about length of mesosoma (*I. agilis* species-group).... ..... **14**

    Viewed from front, head capsule ≤1.5 times as long as wide, its widest point at about its midpoint (Figure 158); vertex of head capsule straight or concave; appendages shorter, < length of mesosoma..... **16**

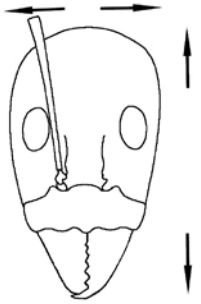

Figure 157

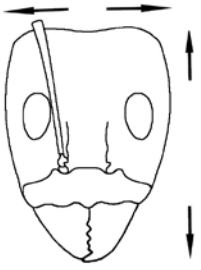

Figure 158

14. Larger species (HW > 1 mm); red-and-black ....***I. agilis* Forel**

    Smaller species (HW < 1 mm); concolorous black or dark brown..... **15**

15. Pronotum weakly tapered anteriad, attached to head capsule well below level of vertex (Figure 159)..... ***I. bicknelli* Emery**

    Pronotum strongly tapered anteriad, attached to head capsule close to level of vertex (Figure 160) .....***I. agilis* group sp. JDM 85**

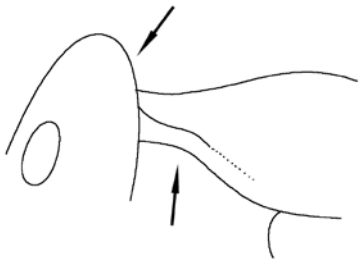

Figure 159

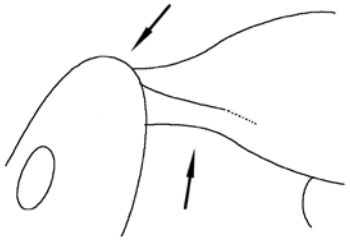

Figure 160

16. Eye very large (eye length ≈ 1/3 of HL), strongly asymmetrical, with outer eye margin almost straight, inner margin convex (posterior lobe of eye also distinctly more narrowly convex than anterior lobe in many larger specimens); colour variable, ranging from depigmented yellow through light brown (most commonly) to black (*I. hartmeyeri* species-group) (Figure 161)..... **17**

Eye smaller (eye length < 1/3 of HL), or eyes ovate or weakly asymmetrical; colour rarely pale (often brown or reddish hues, alone or in combination) (Figure 162) **19**

Figure 161

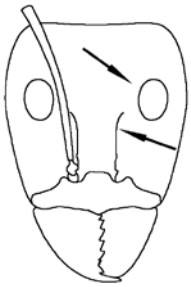

Figure 162

17. Dorsum of mesosoma without erect and suberect setae ..... ***I. hartmeyeri*** **Forel**

    Dorsum of mesosoma with erect and suberect setae **18**

18. Viewed from front, sides of head capsule with a few to many short, erect setae; antennal scape often with short, erect setae along its length (Figure 163) ....***I. hartmeyeri*** **group sp. JDM 849**

    Viewed from front, sides of head capsule without short, erect setae; antennal scape without erect setae except at extreme tip..... ..... ***I. dromus*** **Clark (Figure 164)/*I. exsanguis* Forel (Figure 165)**

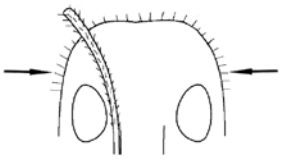

Figure 163

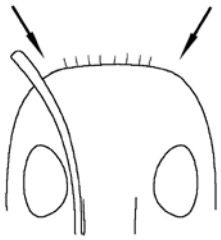

Figure 164

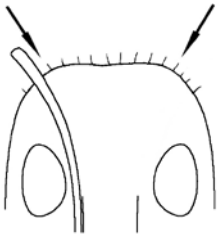

Figure 165

19. Antennal scape with erect setae along its length **20**

    Antennal scape with erect setae confined to the extreme tip **23**

20. In full-face view, head shape (excluding the mandibles) variably trapezoidal, the posterior (occipital) angles moderately to much wider apart than the anterior angles (i.e. where mandibles are articulated); size generally larger, HW ≥ 1.5 mm (Figure 166)..... .....***I. discors*** **Forel**

    In full-face view, head shape (excluding the mandibles) rectangular, sides of head capsule convex to almost straight, posterior angles approximately as wide apart as anterior angles (Figure 167); size generally smaller, HW ≤ 1.5 mm..... **21**

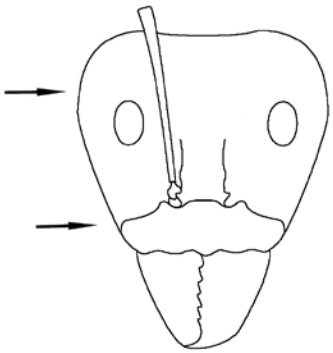

Figure 166

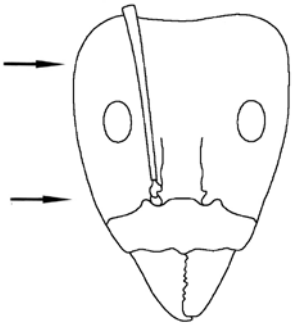

Figure 167

21. In profile, mesosoma strongly biconvex, the pronotum rounded and strongly declivitous towards head; propodeum truncate and raised above plane of mesonotum, its dorsal face about as long as its declivitous face (Figure 168) ....***I. chasei*** **Forel (pt.)**

    In profile, mesosoma undulant, with pronotum gently convex; propodeum rather long, and on same plane as mesonotum; its dorsal face distinctly longer than its declivitous face (Figure 169)..... **22**

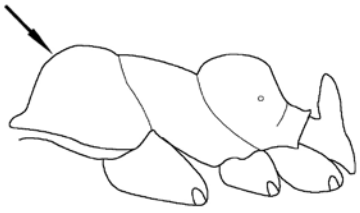

Figure 168

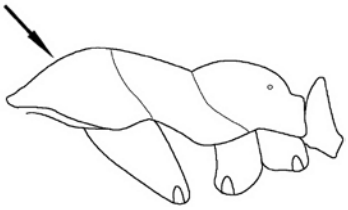

Figure 169

22. Erect setae sparse, mostly confined to outer surface of scape (Figure 170) ....***Iridomyrmex* sp. JDM 846**

    Erect setae abundant, and found on all surfaces of scape for most of its length (Figure 171)..... .....***I. gracilis spurcus* Wheeler**

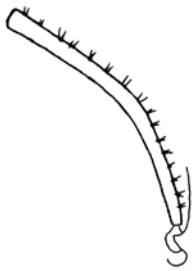

Figure 170

Figure 171

23. Propodeum longer than high, without a noticeable propodeal angle (generally rather large, gracile ants (Figure 172). (n.b. *Iridomyrmex anceps* (Roger) will also key out here, but is smaller than the two species in couplet 23, i.e. HW 0.8 mm < compared with HW 0.9 mm >)..... **24**

    Propodeum about as long as high with a noticeably protuberant, though blunt propodeal angle (non-gracile ants) (*I. rufoniger* species-group) (e.g. Figure 173)..... **25**

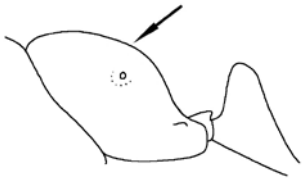

Figure 172

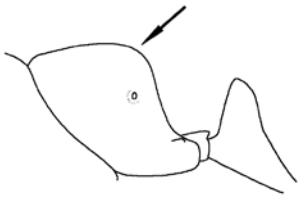

Figure 173

24. Head and mesosoma brick-red or reddish orange .....***Iridomyrmex* sp. JDM 133**

    Head brown, mesosoma orange-brown..... .....***I. bicknelli brunneus* Forel**

25. In full-face view, vertex of head weakly to strongly concave; in profile, pronotum strongly rounded, arising abruptly anteriad; > 8 erect setae on its dorsum; propodeum rising above level of metanotum, its dorsum either protuberant or flattened, if the latter then often with a minute indentation..... ..... **26**

    Without the full suite of the above characters (though one or more of these features may be present) (several species in the *mattiroloi* complex) **28**

26. Large, broad-headed species (HW ≥ 0.8 mm, often > 1 mm); gaster with distinct greenish or greenish-blue iridescence..... ..... ***I. rufoniger domesticus* Forel**

    Smaller species (HW ≤ 0.5 mm); gaster with, at most, weak, coppery iridescence (ants in the *I. chasei* complex) **27**

27. Brown species, usually concolorous (mesopleuron may have lighter areas); erect setae on pronotum 12 <; propodeum flattened, often slightly indented medially (Figure 174).. .....***I. chasei concolor* Forel**

    Orange-and-brown species, darker specimens always with some orange areas on mesosoma; erect setae on mesosoma 15 ≥; propodeum usually rounded, occasionally indented medially (Figure 175)..... ***I. chase*i Forel (pt.)/ *I. chasei yalgooensis* Forel**

Figure 174

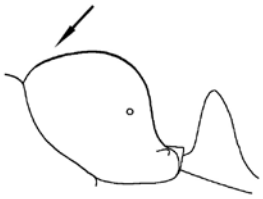

Figure 175

28. Worker without erect setae on mesosoma **29**

    Worker with at least a few minute erect setae on mesosoma **30**

29. Eye larger (length 0.25 > × length head capsule); shades of medium to dark brown; drier north and north-east of SWBP ..... ***Iridomyrmex* sp. near *rufoniger suchieri* Forel**

    Eye smaller (length 0.25 < × length head capsule); dark brown to black with bluish-green iridescence; south coast..... .....***I mattiroloi* complex sp. JDM 845**

30. In full-face view, sides of head capsule with 6 > erect setae (Figure 176) .... ***I. rufoniger suchieri* Forel (population 2)**

    In full-face view, sides of head capsule with 3 ≤ erect setae, setae usually lacking (Figure 177). **31**

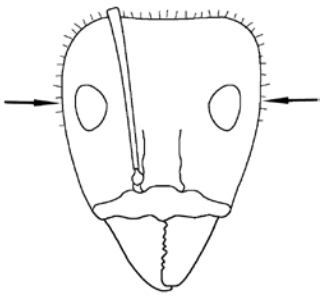

Figure 176

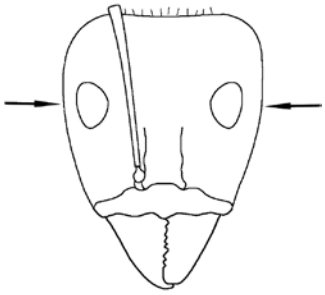

Figure 177

31. In profile, anterior pronotum rising more-or-less steeply towards its junction with mesonotum (Figure 178a); in dorsal view, sides of pronotum forming a symmetrical curve (Figure 178b); ant black or greyish-brown (brownish in northern sandplains) with blue to greenish-yellow iridescence; propodeum smoothly rounded (Figure 179); eye smaller (length 0.25 < × length head capsule) ....***I. mattiroloi splendens* Forel**

    In profile, anterior pronotum forming a gradual, even curve towards its junction with mesonotum (Figure 180); in dorsal view, sides of pronotum forming an asymmetrical curve (Figure 181); ant usually a coppery brown, rarely with patches of blue to greenish-yellow iridescence on body; propodeum often not smoothly rounded in profile, its dorsum slightly to moderately flattened posteriad (Figure 182a) or protuberant (Figure 183a); eye larger (length 0.25 > × length head capsule).... ..... **32**

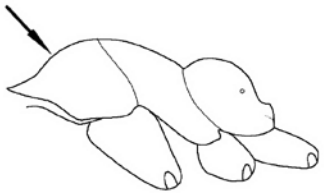

Figure 178a

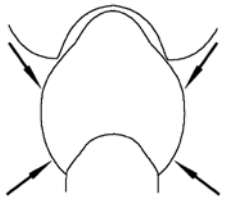

Figure 178b

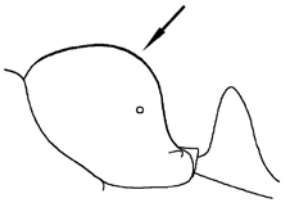

Figure 179

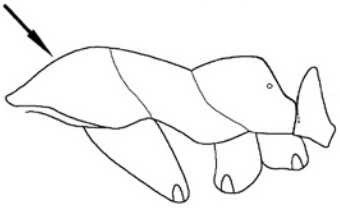

Figure 180

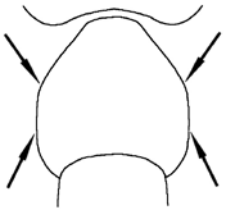

Figure 181

32. Dorsum of propodeum sloping, slightly flattened posteriad, propodeal angle indistinct (Figure 182a); scape longer, exceeding vertex of head capsule by more than 0.25 × its length (Figure 182b) ....***I. mattiroloi continentis*** **Forel**

Dorsum of propodeum flat or weakly convex, nearly always connecting with the declivitous face through a distinct, though blunt, angle (Figure 183a); scape shorter, exceeding vertex of head capsule by much less than 0.25 × its length (Figure 183b)..... ..... ***I. rufoniger suchieri*** **Forel (population 1)**

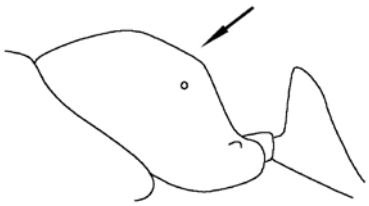

Figure 182a

Figure 182b

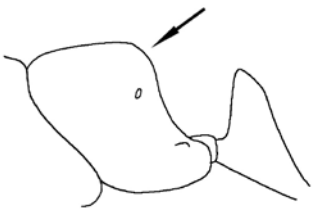

Figure 183a

Figure 183b

Iridomyrmex can be recognized by the head shape and high placement of the compound eyes on the head capsule. Most members of the genus also have a central clypeal projection, but this feature can be very minute and difficult to see in many species. In the SWBP, *Iridomyrmex* is a very large group (32 species), and includes perhaps the best-known ants in this part of Australia, with the possible exception of the bulldog-ants. The genus is very important ecologically, and a summary of the more pertinent aspects of their biology and ecological relationships is given in Shattuck (1999). Many of the species that form large nests are very aggressive, and impact on other ant species around them. Conspecific ants from separate nests are not exempt from that aggression, and it is not uncommon to see a luckless *Iridomyrmex* worker being stretched by others of its own kind. *Iridomyrmex*, however, fare less well against similarly aggressive exotic tramp species such as the Argentine ant and the big-headed ant, and will gradually retreat from areas that are occupied by such taxa. This has happened in large parts of the Perth metropolitan area, where aggressive tramp species now dominate (Heterick *et al.* 2000). However, where tramp ants are controlled (e.g. the big-headed ant through the use of AMDRO ®) members of the *I. rufoniger* species-group are among the first native ants to recolonize treated areas. *Iridomyrmex* species are generalist carnivores and scavengers, and also feed on nectar and the exudates of Hemiptera and lepidopteran caterpillars.

In built-up or highly disturbed areas, members of the *I. rufoniger* species-group dominate. These are mainly small reddish or brown-and-black ants, but also include dark species in what I here call the *I. mattiroloi* complex. The native odorous ant, *Iridomyrmex chasei* Forel, is certainly conspecific with *Iridomyrmex chasei yalgooensis* Forel, and possibly also with taxa described from the eastern states. This species and its relatives also form an easily recognizable unit (here, the *Iridomyrmex chasei* complex) within the *I. rufoniger* species-group. These ants are readily distinguished by their protuberant pronotum and propodeum, and the concave vertex of their head capsule. *Iridomyrmex chasei* is an invariable part of the insect fauna of cities and suburbs in the SWBP, where it forms huge colonies, often on sandy soils. When colonies are at their

peak in the spring and summer months, the amount of sand displaced by their burrowing activities is enormous. *Iridomyrmex chasei* is also common in heathland and other sandy areas. However, it is much less common in timbered and modified rural habitats in the SWBP, where it is largely replaced by a dull brown relative, *Iridomyrmex chasei concolor* Forel. The latter swarms in huge numbers in areas transformed or denuded of their natural cover by human activity. *Iridomyrmex rufoniger domesticus* Forel is a thickset, broad-headed, semi-arid to arid area species (at least, in the SWBP) with a strongly convex pronotum suggestive of *I. chasei*. However, unlike the latter, its gaster possesses bluish-purple iridescence. *Iridomyrmex rufoniger domesticus* is an opportunist, and builds populous colonies in disturbed areas such as mine sites. This ant was described from material collected from near Sydney, NSW, and probably also occurs in other southern Australian states.

The most common member of the I. *mattiroloi* complex, *Iridomyrmex rufoniger suchieri* Forel, is found in much the same habitats as *I. chasei*, and *I. chasei concolor*, but differs from them in the less convex shape of its pronotum and its more compact propodeum. The taxon has several populations in the SWBP that, on closer inspection, may prove to be different species. One of these is a very hairy form with timid behavioural traits that is not uncommon in the Perth area. In the north, on the other hand, is a population that completely lacks erect setae on the mesosoma (*Iridomyrmex* sp. JDM 314). Another form is uniformly dark, with a more rounded propodeum. The latter resembles *Iridomyrmex mattiroloi splendens* Forel, but can be separated through the appearance of the pronotum and its larger eye (see key). Although they are only listed as occurring in the south-west of WA by Taylor and Brown (1985), my perusal of material held in collections, and my personal observations suggest to me that *I. chasei*, *I. chasei concolor* and *I. rufoniger suchieri* occur throughout much of Australia. I suspect a few populations of a very similar species, *Iridomyrmex anceps* (Roger), may also occur in the south-west, and have possibly been confused with *I. rufoniger suchieri* in the past. This species is virtually identical to the latter, but can be distinguished by the slightly longer and less truncate propodeum, the propodeum, in fact, being identical with that of *Iridomyrmex bicknelli bruneus* Forel. *Iridomyrmex anceps* is very common in the more northerly regions of the State.

The *Iridomyrmex mattiroloi* complex in the SWBP comprises at least three other dark brown or black species. *Iridomyrmex mattiroloi splendens* Forel occurs frequently in wetter parts of the south-west, commonly in association with fallen logs and timber debris, but has also been collected in the eastern Pilbara. Nests can be found under logs or stones, as well as in uncovered soil. In the field, this species superficially resembles the more gracile *Iridomyrmex bicknelli* Emery, of the *agilis* species-group, and most populations also possess the same bluish- or greenish-yellow iridescence. This species may well be conspecific with *Iridomyrmex vicinus* Clark from eastern Australia. Populations found in the wheatbelt east of Perth tend to have very small, compact workers with a conspicuously protuberant propodeum. These lack the iridescence found in western populations, but I believe, on the balance of probabilities, that they belong to the same species, which is quite size variable. *Iridomyrmex mattiroloi splendens* closely resembles the dark form of *I. rufoniger suchieri*, but can be distinguished through the features mentioned in the key. *Iridomyrmex mattiroloi* complex sp. JDM 845, which lacks erect setae on the mesosoma, is its counterpart on and near the south coast. In drier areas of the State, *Iridomyrmex mattiroloi continentis* Forel is ubiquitous in most habitats. This species differs from *I. mattiroloi splendens* by virtue of its less convex pronotum, rather flattened propodeum, larger eye and longer antennal scape (the scape in *I. mattiroloi splendens* is short, like that of *I. rufoniger suchieri*).

Iridomyrmex discors Forel is a medium-sized red-and-black ant, common on sandy wastes where it appears to be an early pioneer species. At an Eneabba sand-mining lease in 1997, *I. discors* occurred in huge numbers on the most recently rehabilitated sites, but was generally absent in older rehabilitated or undisturbed sites (pers. obs.). In Perth streets, piles of yellow or white sandy soil displaced by this species are a frequent sight on footpaths and verges. *Iridomyrmex discors* occurs throughout Australia, except for the far north and north-west. Elsewhere, the species occupies drier habitats, where it is a generalist predator/scavenger (Shattuck 1996). Details of its morphology and biology suggest that *I. discors* is a close relative of the meat ants[2], four species of which occur in the SWBP. The latter differ chiefly in the nature of the iridescence found on the head and mesosoma (see key). Descriptions of the taxonomy and biology of the group are given in Shattuck (Shattuck 1993a). *Iridomyrmex greensladei* Shattuck is the commonest of the four local species, and is well known to the West Australian public. The large nests of this ant, often covered with small pebbles, may be several metres in diameter, and can be seen anywhere in southern parts of the State outside of the more built up areas. If the mounds are disturbed, angry workers will instantly pour out of the many entrance holes to attack the intruder. *Iridomyrmex viridiaeneus* Viehmeyer has the widest distribution

[2] Andersen (2000) considers that *I. discors* most probably belongs to the *I. purpureus* species-group, but Shattuck (1993a, 1996) keeps the two groups separate.

of all the meat ant species (Shattuck 1993a), and occurs in all of the Australian states. In WA it is absent from the moister south-west and south of the State, and in the SWBP has been found primarily in the eastern wheatbelt and surrounding pastoral country. This is another species that builds large mounds. *Iridomyrmex lividus* Shattuck, by way of contrast, has nests with a single entrance. Specimens collected by the author east of Caiguna, at the edge of the Nullarbor Plain, were a handsome blue-black. This species has been found only in the extreme south-east of the SWBP. A fourth species, *Iridomyrmex reburrus,* Shattuck has been collected (ANIC) from the southeast (Emu Rock and Gora Hill), although its main distribution – and the provenance of the all Curtin specimens – is the north of the state. This species is very similar to I *greensladei*, which also often has short, stiff, erect setae on the sides of the head capsule, but, when seen in profile, can be differentiated from that species by virtue of the shape of the pronotum. *Iridomyrmex bigi* Shattuck, has been collected at Meekatharra in the northern goldfields, and may occur in the far north-east of the SWBP.

Another distinctive species-group is the *I. hartmeyeri* group. The very large, asymmetric eye most readily characterises its members. The taxonomic limits of this group in the SWBP are uncertain, as the taxonomy is difficult. However, *Iridomyrmex hartmeyeri* Forel, itself, is easily recognized as its mesosoma lacks erect or sub-erect setae. This species is found mainly in drier areas of the State, but has also been collected in the North Kimberley. *Iridomyrmex hartmeyeri* group sp. JDM 849 can be identified by the short, erect setae on the sides of the head capsule, and, often, on the antennal scape. This taxon is found in drier areas of the SWBP. I have been unable to satisfactorily separate *Iridomyrmex dromus* Clark and *Iridomyrmex exsanguis* Forel in a key using morphological characters, although each is likely to represent a good species. In general, the short, erect setae on the vertex of the head extend to the corners of the head capsule in *I. exsanguis*, whereas they are confined to the concavity of the vertex in *I. dromus*, but there is a small degree of overlap. *Iridomyrmex exsanguis* workers also tend to be larger than those of *I. dromus*. *Iridomyrmex exsanguis* specimens have been collected on the west coast between Carnarvon and Mandurah, while *I. dromus* was described from SA, and is common throughout WA. The latter exhibits a wide variation in colour: some populations are a depigmented yellow, while a worker collected from Coorow, in the northern wheatbelt, is black! Most workers range from tawny yellow to brown. Both *I. dromus* and *I. exsanguis* are nocturnal foragers.

The *I. calvus* species-group, identified by the uniformly curved frontal carinae (Shattuck 1993b), has five representatives in the SWBP, several of them apparently quite rare. *Iridomyrmex notialis* Shattuck is the most commonly encountered, and its range extends across southern Australia. In the SWBP the ant has been represented in terrestrial collections taken in suburban Perth and several south-western localities. *Iridomyrmex argutus* Shattuck, *Iridomyrmex innocens* Forel and *Iridomyrmex occiduus* Shattuck appear to be the same ant! A queen syntype of *I. innocens*, held at the WAM, clearly belongs to the *I. calvus* species-group, and its non gender-specific features are identical to those of workers identified by Shattuck as *I. occiduus*. Moreover, I here argue that *I. argutus*, described by Shattuck from two specimens, is also *I. innocens*. A worker with the same collection data as the holotype and paratype specimens of *I. argutus*, but with setae on the venter of the head capsule, is housed in the Curtin Ant Collection. A second worker with the same data does not appear to have this feature, (though the setae may be plastered to the head capsule by the alcohol in which the ant had been immersed prior to mounting). This means that a critical distinguishing feature between the two taxa is at least variable, leaving only intensity of head colour (a very feeble character) separating them! In fact, the number of setae under the head in *I. occiduus* varies from two or three to over a dozen in specimens I have inspected. I consider that the three names are synonyms for the same species, the synonym *innocens* having priority. ***Iridomyrmex innocens*** **Forel** is here regarded as the senior synonym of *Iridomyrmex argutus* Shattuck **syn. nov.** and *Iridomyrmex occiduus* Shattuck **syn. nov.** This ant is reasonably common in the Darling Range, and is also found on the south and south-east coasts. The rare *Iridomyrmex hesperus* Shattuck is known from a few specimens taken from near the south coast and from one specimen collected from Queen Victoria Spring Nature Reserve, and *Iridomyrmex prismatis* Shattuck, described on the basis of a few specimens from NSW and Victoria, has recently been collected from near Lake Warden, close to the Esperance townsite.

Iridomyrmex calvus group sp. JDM 1069 is an undescribed species known in the Curtin Collection from specimens collected at Eneabba and from near Ravensthorpe, respectively. Additional specimens in the California Academy of Sciences were collected many years ago in Darlington, now one of Perth's eastern suburbs. The ant is here assigned to the *I. calvus* group because of its evenly divergent frontal carinae and the general appearance of its mesosoma and node. However, placement of this species in the *I. calvus* group or even in the genus *Iridomyrmex* is provisional, workers having a completely emarginate anterior clypeal margin without the hint of a central projection, unlike all other *Iridomyrmex*. Also, unlike most other

Iridomyrmex species, the gaster is rather flat and elongate, rather than spherical, and the node is broad and very low. The propodeal spiracles are situated dorsally, near the propodeal angles, and erect setae are sparse or lacking on the mesosoma. All in all, this is a most striking little ant that is quite unlike any other *Iridomyrmex* species found in the SWBP, though, based on its morphology, the *I. calvus* group is probably the best fit.

The *I. conifer* species-group is restricted to the SWBP. Members of the group are recognizable immediately by the conical shape of the propodeum. The three constituent species can be separated by differences in the pilosity on the head capsule and mesosoma, and Shattuck and McMillan (1998) have reviewed their taxonomy and biology. The well-known stick-nest ant, *Iridomyrmex conifer* Forel, has the broadest distribution of the group, and occurs in the vicinity of Perth and on the south and south-east coasts. This species has the unusual characteristic of building an underground nest in late Spring and Summer and a surface nest in the colder months. Nests are decorated with suitable plant material, the nature of which depends on the plant community in the area. Workers forage primarily for nectar, but also tend Hemiptera, and scavenge dead animal material (invertebrates and small vertebrates) (Shattuck and McMillan 1998). *Iridomyrmex turbineus* Shattuck and McMillan occurs in the wetter south-west, between the main centres of population of *I. conifer*, while *Iridomyrmex setoconus* Shattuck and McMillan is known from two collections near Esperance (Shattuck and McMillan 1998).

The elongate head capsule and long limbs characterise members of the *I. agilis* species-group. These appear to be thermophilic ants, either active in the heat of the day, or found in areas that are highly insolated (such as sand dunes). *Iridomyrmex agilis* Forel is a fairly large red-and-black ant that has a wide distribution in drier areas of the State. The worker has a habit of scurrying about with its gaster directed vertically. *Iridomyrmex bicknelli* Emery was described from Tasmania, but has a wide Australian distribution (Clark 1938). In WA, this slender, iridescent black ant has been recorded as far north as the Pilbara, but most records are from the south-west and the wheatbelt. Workers of this very common species are often seen on suburban footpaths and on sand dunes near beaches. The species is also common on heathland sand-plains near the west coast and in the interior. In mine sites the ant appears to be an early coloniser of newly rehabilitated plots. *Iridomyrmex agilis* group sp. JDM 85 is very similar in appearance, but differs in the length of the anterior projection of the promesonotum, and the position of its articulation with the head capsule. The ant has been recorded from Perth north to Eneabba. The worker of *Iridomyrmex bicknelli splendidus* Forel collected from Perth, was described (1902) in just two lines. I have not seen a type specimen and am unable at present to identify this taxon among the *Iridomyrmex* material I have seen.

Iridomyrmex bicknelli brunneus Forel (conspecific with *Iridomyrmex gracilis minor* Forel, in my opinion), *Iridomyrmex gracilis spurcus* Wheeler, *Iridomyrmex* sp. JDM 133 and *Iridomyrmex* sp. JDM 846 are here identified as probably belonging to the *I. gracilis* species-group. Workers of this group have a rather elongate propodeum and long femora, but the outline of the vertex of the head capsule is straight or slightly concave, rather than convex, as in the *I. agilis* species-group. *Iridomyrmex bicknelli brunneus* is quite common in woodlands in the SWBP, and probably occurs widely throughout Australia, though only listed for WA ('*I. bicknelli brunneus*') and QLD and WA ('*I. gracilis minor*') by Taylor and Brown (1985). This ant is often encountered foraging on the trunks and branches of eucalypts. The closely related *Iridomyrmex* sp. JDM 846 is very similar, but is uniformly brown to dark brown rather than reddish-brown and dark brown, and has erect setae on the outer surface of the antennal scapes. A few erect setae can also be found on the last quarter of the inner surface. This taxon has a wide distribution in drier eastern and northern areas of the SWBP, but is also found in Jarrah forest, and one series has been collected from Mutton-bird Island near Albany and another from Esperance, on the south coast. *Iridomyrmex gracilis spurcus* is a rather small member of the group, and extremely hirsute, with erect seta on all surfaces of the antennal scape. This is a typically eastern and northern form, found at least as far north as the Pilbara. The type material was collected at Moorilyanna in SA. Ground foraging workers of *Iridomyrmex* sp. JDM 133 have been collected in the northern sector of WA, including the north of the SWBP. From its description, I consider that *Iridomyrmex* sp. JDM 133 may be identical with *Iridomyrmex gracilis fusciventris* Forel, but I have not seen type specimens of the latter.

Linepithema

One species, Linepithema humile *(Mayr), the Argentine ant.*

Linepithema species appear similar to *Iridomyrmex*, but the eyes are placed lower on the head capsule, and the clypeal margin is shallowly concave, without a central protuberance. Only one species, the introduced Argentine Ant (*Linepithema humile* (Mayr), occurs in Australia. The ant can be found in a number of towns in south-west WA, as well as throughout the Perth metropolitan area. This pest species has gained a firmer foothold in suburban

areas of Perth since the cessation of heptachlor spraying in 1988. Fortunately, the ant has thus far not penetrated large, intact tracts of native vegetation in the SWBP, though infestations have been treated in disturbed woodland near Augusta and Margaret River (M. Widmer, Agriculture Department of WA, pers. comm.) However, since *L. humile* prefers humid environments, native riparian plant communities in the south-west of this State remain at risk.

Nebothriomyrmex

One species, Nebothriomyrmex majeri *Dubovikov.*

Nebothriomyrmex majeri, the only species described under this newly erected genus (Dubovikov 2004), has tiny, depigmented workers. Members of this genus can readily be distinguished from Arnoldius by their PF of 6,4 and their pronotal protuberance. Although it is not uncommon in the Darling Range, the author has found this ant to be particularly abundant in coastal peppermint (*Agonis flexuosa*) scrubland around Bremer Bay. Here, many clusters of ant colonies can be found in white sand under rotted wood and around tree and shrub roots. Given their close association with roots in these circumstances, they may be tending root aphids or other Hemiptera.

Ochetellus

1. Body chocolate to black, appendages dark brown..... ***O. glaber* group sp. JDM 19**

   Head, mesosoma, node and appendages orange or red; legs light brown to brown, gaster dark brown..... ***Ochetellus* sp. JDM 851**

Species of *Ochetellus* resemble small *Dolichoderus* (subgenus *Hypoclinea*) in terms of their concave propodeum, but differ in lacking a flange on the underside of the head capsule near the mandibular insertions. The petiolar node is also very thin and broadly expanded, compared with the thicker, more oblique and narrower node in *Dolichoderus.* The shallowly concave anterior margin of the clypeus found in *Ochetellus* also separates that genus from small *Iridomyrmex* with a flattened propodeum. In the SWBP these ants can mostly be found in association with wood, either in the form of living timber or on timber products and structures (e.g. telegraph poles), where they form thin, trailing columns. Members of this genus can be a nuisance in suburban homes, where they frequent kitchens and other places where sweet foodstuffs can be found.

At least two species can be found in the SWBP. A further two species, including the Spinifex Ant (*Ochetellus flavipes* (Emery)), are found north of the Province. *Ochetellus glaber* group sp. JDM 19 is of uncertain taxonomic status. Variation can include degree of pilosity and sculpturation. Some specimens are rather matt, with thick pubescence on head, mesosoma and gaster, whilst in others the small, appressed setae are sparser and more widely separated, particularly on the head, and they have a smoother, shinier appearance. The latter agree with the form *Ochetellus punctatissimus* (Emery), based on ANIC material. This species or species complex is by far the most common of the two local forms. *Ochetellus* sp. JDM 851, with reddish foreparts, has never been formally described and named, though recognized in manuscript (ANIC material). This form has been collected rarely in the south-eastern wheatbelt, near the south-east coast, and in the mid west.

Papyrius

1. Vertex of head capsule, first gastral tergite and node with erect setae; large species (HW 1 mm.>..... ***Papyrius* sp. JDM 666**

   Vertex of head capsule, first gastral tergite and (usually) node lacking erect setae; smaller species (HW ≤ 1 mm) .... ***P. nitidus* (Mayr)**

Papyrius species can be recognized by their short palps (PF 5,3) and truncate propodeum, the latter part often possessing a distinct anterior protuberance or lip. The odour produced by *Papyrius* workers is also distinctive and aromatic in nature. These ants often nest in or at the base of trees, and the carton (plant fibres and/ or frass) used to cover their nests and trails may cause their activities to be mistaken for those of termites. Workers will tend the caterpillars of various butterflies (Shattuck 1999). The ants may occasionally be pests in homes: the author has received at least one complaint - a country resident who advised that the ants were infesting timber in his studio.

Two species of *Papyrius* are known from the SWBP. *Papyrius nitidus* (Mayr) is widespread in the SWBP, and also occurs in the Kimberley Region in this State. Other records are from NSW and the NT. *Papyrius* sp. JDM 666 has been recorded from the Darling Range and the eastern and southern wheatbelt.

Tapinoma

(n.b. *Tapinoma rottnestense* Wheeler is actually a *Doleromyrma.*)

1. Foreparts dark brown, strongly contrasting with pale gaster and appendages .... ***T. melanocephalum* (Fabricius)**

   Foreparts, gaster and appendages more-or-less concolorous **2**

2. Eye large, eye length ≈ 1/3 length of head capsule (Figure 184) .... ***Tapinoma* sp. JDM 981**

Eye smaller, eye length ≤ 1/4 length of head capsule (Figure 185) .....***Tapinoma* sp. JDM 78**

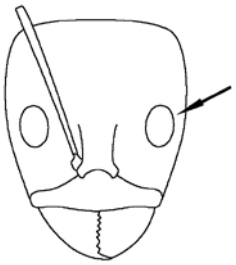

Figure 184

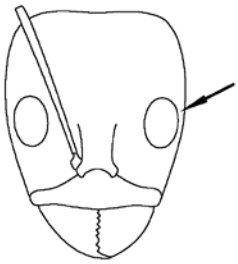

Figure 185

Distinguishing workers of *Tapinoma* and *Doleromyrma* can be very difficult (see my comments under the latter). Otherwise, workers of *Tapinoma* will not be confused with those of any other ants. Local species have often been collected in the evening or at night, and are frequently found foraging on trees. In woodlands, nests are most commonly found under stones, in rotting wood or in litter. The ants are general scavengers, but also take honeydew (Shattuck 1999). Shattuck also reports that they tend aphids or coccids.

At least two indigenous species of *Tapinoma* occur in the SWBP. The taxonomy is rendered more difficult by their small size and tendency to shrivel when pointed. However, one species described from material collected on Rottnest Island, i.e. *Tapinoma minutum rottnestense* Wheeler, is a *Doleromyrma* species (see comments under that genus). *Tapinoma* sp. JDM 78 is here separated from the other taxon by its smaller eye. Workers also have a more rounded head capsule. Specimens have been collected from a variety of situations, including pitfall traps, hand collections off tree trunks and from litter, even from a sink inside a house (Broome). The ant has been gathered mainly in coastal localities throughout the State, but one series has been taken near Kalgoorlie. A small-eyed variant, which is more uniformly yellow in colour, may represent a different species. Specimens of this form have been collected from several widely separated localities, including Jurien Bay in the mid north, and Broome, in the Kimberley Region. The large-eyed *Tapinoma* sp. JDM 981 has a more rectangular head capsule, like *Doleromyrma*. Most records are from the arid zone and in the Pilbara, but this ant has occasionally been taken in the Darling Range.

The exotic ghost ant (*Tapinoma melanocephalum* (Fabricius)) may well have become established in the Perth region: recently, two workers were collected in a pitfall trap in rehabilitated vegetation in the Perth suburb of Mosman Park, while a Curtin University project was being undertaken, and the author has also been asked to identify ant material from another Perth suburb that proved to be of this species. This ant, as the common name suggests, has an extremely pale gaster and legs that contrast strongly with the dark brown head and mesosoma, and thus enable it to be distinguished easily from the native taxa.

Technomyrmex

One species, Technomyrmex jocosus *Forel.*

On a global scale, *Technomyrmex* species may be confused with *Tapinoma*, but in the SWBP there is a large size difference between the medium-sized *Technomyrmex* workers and those of the local *Tapinoma*, which are minute ants. *Technomyrmex* also has five visible gastral tergites while there are four in *Tapinoma*. Only *Technomyrmex jocosus* Forel occurs in the SWBP, where it is something of a nuisance in some Perth suburbs and, occasionally, in country towns. Outside of houses, workers are most often seen trailing on fence-lines or on tree trunks. Within the central SWBP the species can also be found in disturbed areas such as parkland but does not appear able to penetrate large areas of native vegetation. However, further south, where it may be indigenous, the author has found *T. jocosus* in enormous numbers on karri and tingle trees near Pemberton, and in Banksia woodland west of Albany. This ant is very similar to the better-known exotic *Technomyrmex albipes* (F. Smith), but can readily be differentiated through its shinier, less sculptured head capsule and different arrangement of erect setae on the frons. Barry Bolton is currently revising the world fauna of this genus.

SUBFAMILY FORMICINAE

Formicinae are readily recognized by the presence of an acidipore on the tip of the gaster. This is the only ant subfamily that produces formic acid. The subfamily includes the well-known sugar ants (*Camponotus*) and several other large genera. Although the subfamily has somewhat fewer genera than the Myrmicinae, in terms of sheer numbers of species this is the largest subfamily in the SWBP. For instance, the genera *Melophorus* and *Stigmacros* have around 30 representatives in the SWBP, while

with *Camponotus* the figure is approximately 75 species. The physical appearance of the different genera is rather more uniform than is the case with the Myrmicinae, but there is more morphological diversity than in the Dolichoderinae. Species range from minute cryptic forms living in litter to relatively huge ants, with major workers in excess of 1.5 cm in length. Most are general scavengers and predators, with some adapted to foraging at the hottest times of the day and others nocturnal. A few genera, e.g. *Acropyga*, have specialized habits.

Acropyga

1. Larger species (HW > 0.6 mm); bright yellow, mesonotum strongly convex, prominent .... ***Acropyga myops* Forel**

   Smaller species (HW < 0.6 mm); pale, depigmented; mesonotum only weakly convex ..... ***Acropyga pallida* (Donisthorpe)**

These ants cannot be confused with any other formicine because of their combination of short palps (PF 2,3), minute compound eyes and 10–11 segmented antennae (11 segments in the local species). At least some species of these ants are known to have a heavy reliance on Hemiptera, particularly mealybugs. In the case of the northern Australian *Acropyga acutiventris* Roger, the queens carry fertilized mealybugs in their mandibles during their nuptial flight so that the new *Acropyga* colony will be assured of a reliable food supply (Williams 1978, 1985; Williams and Watson 1988).

Two species of *Acropyga* are known from the SWBP. The commonest of these is *Acropyga myops* Forel. Probably on account of its subterranean habits, this ant is rarely encountered. The species was originally described from Mundaring as *Acropyga indistincta* Crawley, but this name has recently been reduced to a synonym (LaPolla 2004). The ant is widespread, especially in coastal parts of the Australian mainland. *Acropyga pallida* (Donisthorpe) is widely distributed in eastern Australia, but there is one confirmed record (ANIC) from Walpole for the SWBP. The Curtin Ant Collection has no specimens of the latter species.

Calomyrmex

1. Pubescence on gaster thick, bright yellow..... ..... ***C. glauerti* Clark**

   Pubescence on gaster sparse, white..... ..... ***Calomyrmex* ANIC sp. 1**

Calomyrmex workers are easily mistaken for those of *Camponotus* in the field, and it requires microscopic examination to see that this genus possesses a metapleural gland, a structure that is lacking in all West Australian *Camponotus*. *Calomyrmex* workers are also monomorphic, whereas SWBP *Camponotus* workers are polymorphic. All of the Western Australian species are distinctly hairy, and many have very striking green, blue or purple iridescence on the foreparts with sometimes a contrasting yellow or gold pubescence on the gaster. The underlying body colour, however, is always dark. Foragers can be seen collecting nectar from flowers and extrafloral nectaries, or carrying dead arthropods back to their nests. If workers are handled, they will exude a whitish or orange viscous fluid from the base of their mandibles. The colour varies with the age of the worker, and the fluid acts as an alarm to other workers, or operates as a defensive mechanism (Shattuck 1999)

Calomyrmex ANIC sp. 1 has a wide distribution through central and northern SWBP, while *Calomyrmex glauerti* Clark was described from material collected from beside the Murchison River, and occurs in the far north of the Province. The latter is easily distinguished by the thick, yellow or orange pubescence on its gaster, *Calomyrmex* ANIC sp. 1 having only sparse, whitish pubescence. *Calomyrmex* ANIC sp. 1 appears to be absent from the wetter south-west corner of the State, and to commence its range north and east of Perth. In workers of *Calomyrmex* ANIC sp. 1 collected from southern parts of its range cuticular iridescence is reduced or absent, and the general appearance of the ant in the field is a dull greyish-black. Workers from further north, however, often have a dark green to olive-green iridescence on their foreparts. This tends to change to purple in older, pinned specimens, or those that have been damaged through handling. This species can be quite pugnacious if its nest is disturbed, and it is a conspicuous component of the ant fauna on middle-aged and older rehabilitated mineral sand sites at Eneabba.

Camponotus

The key to major and minor workers in the *C. consobrinus* species-group is taken from McArthur and Adams (1996; modified).

Major workers

(n.b. This key provides couplets to known major workers: major workers for a number of species are as yet unknown, as this subcaste tends to leave the nest less frequently than the minor and media worker castes.)

1. Inner surfaces of middle and hind tibiae lacking elongate setae (Figure 186a); anterior two thirds of clypeus and surrounding genae abruptly truncate (used by the ant to plug the nest entry hole in wood) (Figure 186b) ..... ***(C. macrocephalus* species-group) *C. gasseri* Forel**

Inner surfaces of middle and hind tibiae with double row of stout spines (Figure 187); clypeus and adjoining sectors of head capsule not as above **2**

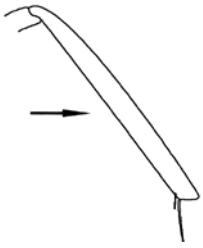

Figure 186a

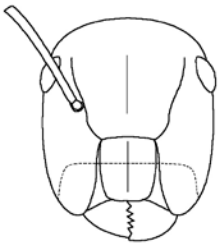

Figure 186b

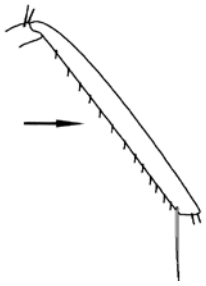

Figure 187

2. Mentum with elongate, J-shaped setae near its posterior margin (*C. wiederkehri* species-group) (Figure 188)..... **3**

Without elongate J-shaped setae on posterior margin of mentum (Figure 189)..... **9**

Figure 188

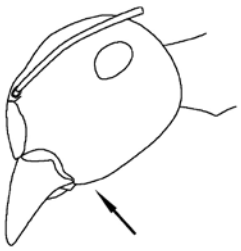

Figure 189

3. Antennal scape and tibiae with many erect, bristly setae **4**

Antennal scape and tibiae lacking erect, bristly setae **5**

4. Dorsum of petiolar node bluntly rounded, node thick (Figure 190a); pubescence on gaster abundant, individual setae overlapping (Figure 190b) ..... ***C. gouldianus*** **Forel**

Dorsum of petiolar node acuminate in profile, node thin, scale-like (Figure 191a); pubescence on gaster less abundant, individual setae usually not overlapping (Figure 191b) ....***C. terebrans*** **(Lowne)**

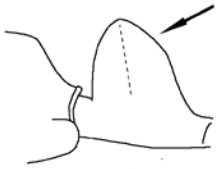

Figure 190a

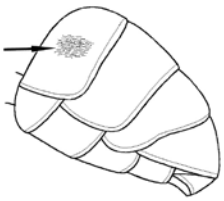

Figure 190b

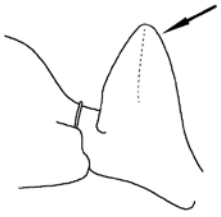

Figure 191a

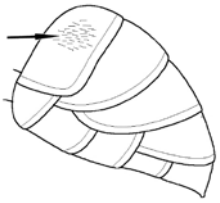

Figure 191b

5. In profile, posterior angle of vertex acute, relatively sharp; outline of mesosoma almost circular in outline (Figure 192)..... ..... ***C. postcornutus*** **Clark**

In profile, posterior angle of vertex obtuse, smoothly rounded; outline of mesosoma not as above (pronotum is convex, mesonotum and dorsal surface of propodeum form a straight line, except for impression of metanotal groove) (Figure 193) **6**

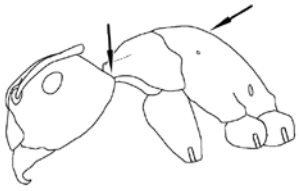

Figure 192

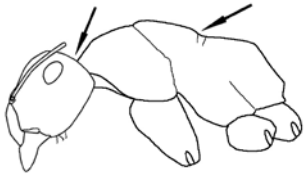

Figure 193

6. In profile, vertex of petiolar node broadly rounded; metanotal groove distinctly impressed (Figure 194) ..... ***C. versicolor*** **Clark**

   In profile, vertex of petiolar node tapering to a sharp or blunt point; metanotal groove feebly impressed (Figure 195) **7**

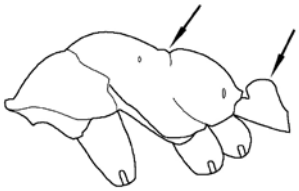

Figure 194

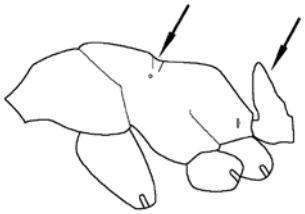

Figure 195

7. Clypeus projecting as a rectangular disc with sharp angles (Figure 196) ..... ***C. wiederkehri*** **Forel**

Anterior clypeal margin broadly convex across its width (Figure 197) **8**

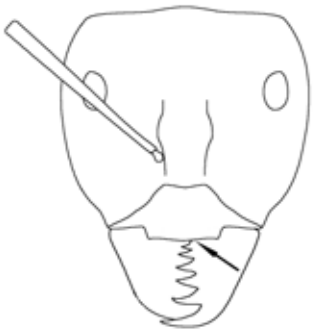

Figure 196

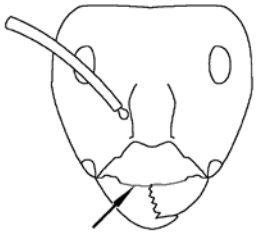

Figure 197

8. Profile of mesosoma weakly predominantly convex; dorsum of propodeum weakly convex, anterior face of petiolar node only slightly shorter than its posterior face (Figure 198) ..... ***C. prosseri*** **Shattuck and McArthur**

   Profile of mesosoma strongly sinuate; dorsum of propodeum almost straight, anterior face of petiolar node much shorter than posterior face, node inclined forward (Figure 199) ..... ***C. johnclarki*** **Taylor**

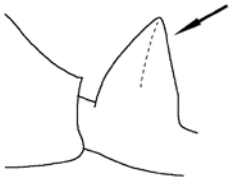

Figure 198

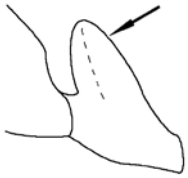

Figure 199

9. Clypeus with anteromedial notch; clypeus projecting beyond genae, clypeal angles acute (*C. nigriceps* species-group) (Figure 200) **10**

   Conformation of clypeus not as above **14**

10. Setae on venter of head capsule absent (Figure 201) ..... ***C. longideclivis*** **McArthur and Adams**

    Setae on venter of head capsule present (Figure 202) **11**

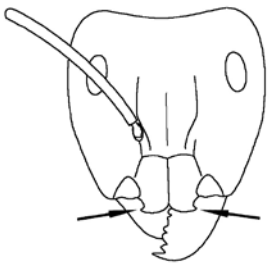

Figure 200

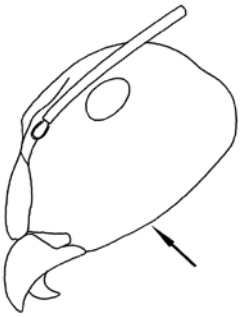

Figure 201

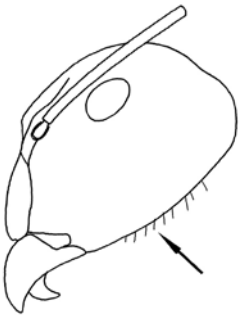

Figure 202

11. Dorsum of propodeum with 10 > erect setae, setae distributed over propodeum (Figure 203) **12**

    Dorsum of propodeum with 10 < erect setae at or near propodeal angle (Figure 204)..... **13**

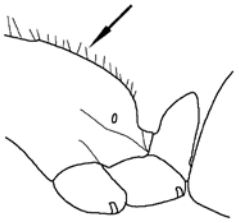

Figure 203

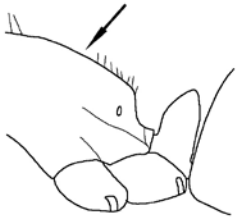

Figure 204

12. Head, mesosoma, node and most of gaster uniformly honey coloured..... ..... ***C. clarior*** **Forel**

    Head black or brown, mesosoma yellow or red-brown..... ***C. nigriceps*** **(F. Smith)**

13. Erect setae on venter of head capsule 20 >, or setae covering more than 1/2 venter area; typically, head dark brown or black, mesosoma yellowish to dark red and gaster brown or black, with or without yellowish colouration anteriad (Figure 205) ....***C. dryandrae*** **McArthur and Adams**

    Erect setae on venter of head capsule 20 <, or setae covering less than 1/2 venter area; typically, head, mesosoma and gaster concolorous dark brown or black (Figure 206) .....***C. prostans*** **Forel**

14. Body and appendages covered with dense, whitish, erect setae; head deeply concave; anterior margin of clypeus simple, not bilobate or bidentate (*C. intrepidus* species-complex) (Figure 207) ....***C. molossus*** **Forel**

    Body and appendages not covered with dense, whitish, erect setae (*C. whitei* has dense, yellow, bristly setae) or anterior margin of clypeus emarginate **15**

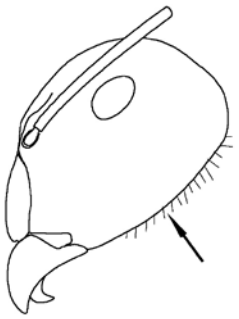

Figure 205

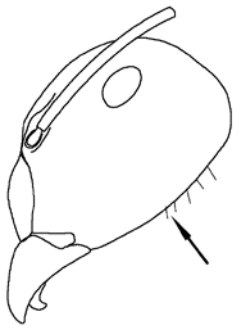

Figure 206

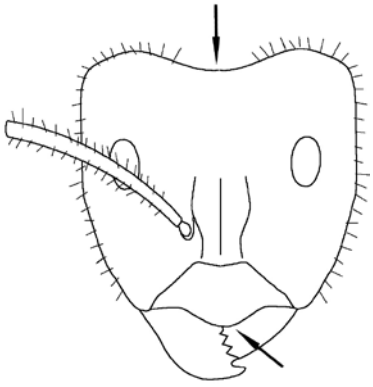

Figure 207

15. Sculpture densely punctate; in profile, mesosoma with mesonotum abruptly descending to propodeum, the latter compact and rounded in outline (dorsal surfaces of body with many yellow, bristly setae) (Figure 208) .... ***C. whitei*** **Wheeler**

Sculpture not densely punctate; mesonotum not abruptly descending to propodeum (e.g. Figure 209)..... **16**

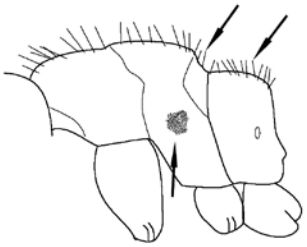

Figure 208

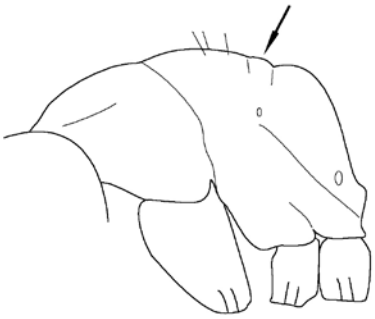

Figure 209

16. In full-face view, head with posterior angles of vertex rounded in shape of small lobes, the outline of the head between them straight; antennal scape not reaching vertex; sides of head usually parallel; anteromedial margin of clypeus protruding, bidentate; mandible strongly sculptured, with six teeth and denticles; outline of mandible strongly rounded (*C. ephippium* species-complex) (Figure 210)..... **17**

In full-face view, head capsule differing in one or more of the above characters; mandible may have more or fewer teeth (e.g. Figure 211) **25**

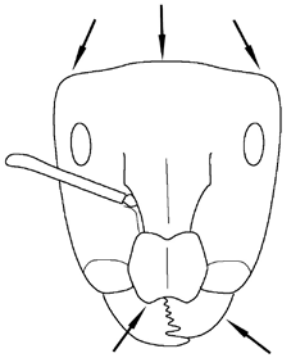

Figure 210

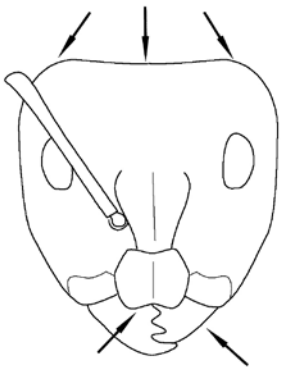

Figure 211

17. Scapes with whorls of erect setae (Figure 212)..... ..... ***C. pawseyi*** **McArthur**

Scape without erect setae except for one or two at the end (Figure 213)..... **18**

Figure 212

Figure 213

18. At least anterior half of frons and sides of head capsule with short, erect and sub-erect setae (Figure 214)..... **19**

Frons and sides of head capsule totally lacking erect and sub-erect setae (Figure 215)..... ..... **21**

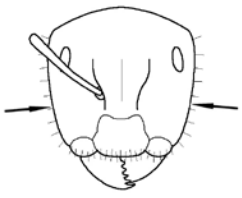

Figure 214

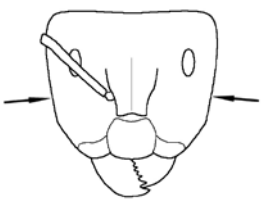

Figure 215

19. Head less massive; in dorsal view, posterior angles of vertex weakly lobate, lobes not reaching humeral angles of pronotum (Figure 216)..... ***C. cinereus notterae*** **Forel**

    Head more massive; in dorsal view, posterior angles of vertex strongly lobate, lobes reaching humeral angles of pronotum (Figure 217) **20**

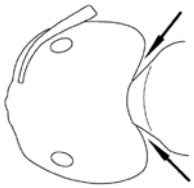

Figure 216

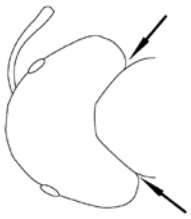

Figure 217

20. Punctation on upper half of frons much fainter than that of lower half; head capsule uniformly red .....***Camponotus*** **sp. near *ephippium* (F. Smith) sp. JDM 431**

    Punctation on upper half of frons almost as strong as that on lower half; head capsule predominantly black with a few dark red patches.....***C. ephippium*** **(F. Smith)**

21. Smaller; HW < 2 mm **22**

    Larger, HW > 2.5 mm **23**

22. Median sector of clypeus narrow, its outline weakly convex, and from about the midpoint carinate and raised above the lateral sectors of the clypeus (Figure 218) ....***C. longifacies*** **McArthur**

    Median sector of clypeus broad, its outline strongly convex, not raised but confluent with the lateral sectors of the clypeus (Figure 219).. ..... ***C. sponsorum*** **Forel**

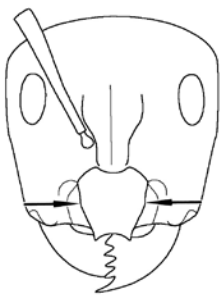

Figure 218

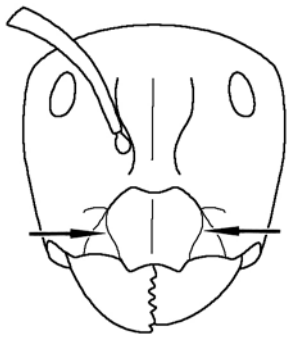

Figure 219

23. Relatively less hirsute, erect setae on mesosoma 30<; setae on venter of head capsule 20<..... ..... ***C. capito ebenithorax*** **Forel**

    Relatively more hirsute, erect setae on mesosoma 30>; setae on venter of head capsule 20>..... ..... **24**

24. Pubescence largely absent from lower mesopleuron and propodeum; legs brown..... ....***C. capito ebenithorax*** **Forel ('black soma')**

    Pubescence present and conspicuous on lower mesopleuron and propodeum; legs orange..... .....***C. dromas*** **Santschi**

25. In profile, propodeum dorsally concave, forming a "saddle" (Figure 220); pronotum and mesonotum black, propodeum and posterior metapleuron bright crimson .... ***C. chalceus*** **Crawley**

In profile, propodeum not dorsally concave (e.g. Figure 221); colour of mesosoma not as above **26**

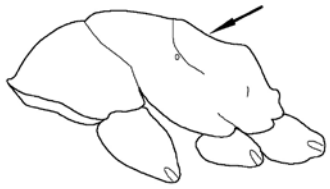

Figure 220

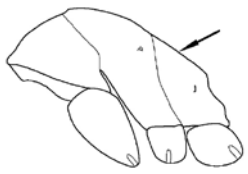

Figure 221

26. Mandibles very large in proportion to head capsule, outer surface of mandible almost circular; number of developed mandibular teeth 7 ≥; in full-face view vertex of head capsule usually straight (Figure 222) **27**

Mandibles of normal proportions, usually triangular, number of developed mandibular teeth 5 or 6; in full-face view vertex of head capsule weakly to moderately concave (Figure 223) **29**

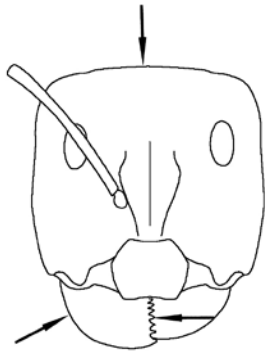

Figure 222

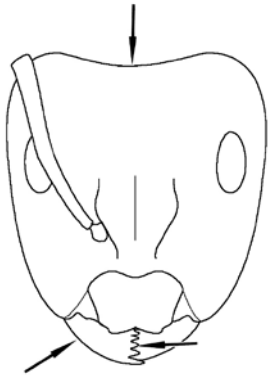

Figure 223

27. Propodeum with transverse notch about midpoint of its dorsal face (Figure 224) ....***Camponotus* sp. JDM 26**

Propodeum without transverse notch (*C. subnitidus* species-group) (Figure 225) **28**

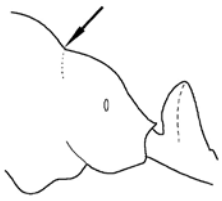

Figure 224

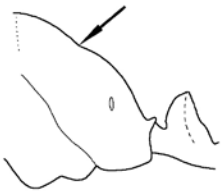

Figure 225

28. One pair of setae present on venter of head capsule, or setae absent .... ***C. rufus* Crawley**

Many setae present on venter of head capsule .... ***C. tricoloratus* Clark**

29. In profile, node thicker, not scale-like, its dorsum flat or only weakly descending towards its anterior face; (Figures 226, 227); ratio of length of propodeum to its declivitous face 1:1–2:1 (Figure 228) **30**

In profile, node thin, scale-like, its dorsum culminating in a sharp point, its anterior face descending vertically or at least at a very acute angle to the vertex (Figures 229, 230); ratio of length of propodeum to its declivitous face usually much less than 1:1 (often 1:2 or 1:3) (Figure 231)..... **31**

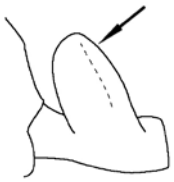

Figure 226

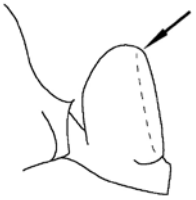

Figure 227

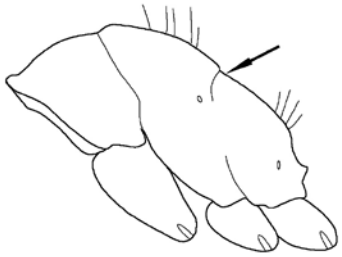

Figure 228

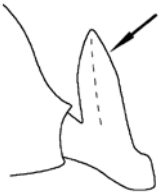

Figure 229

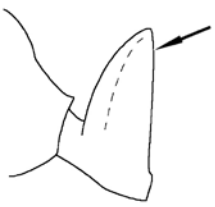

Figure 230

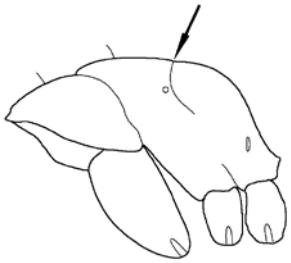

Figure 231

30. Decumbent and appressed setae on propodeum fine, forming pubescence on at least posterior sector, same setae on gaster minute, mostly separated from one another by more than twice their length; foreparts red, gaster black or ant concolorous black ..... ***C. cinereus amperei*** **Forel/*C. pitjantjatarae*** **Forel**

    Decumbent and appressed setae on propodeum coarser and obviously curled, not forming pubescence, same setae on gaster of similar appearance, mostly separated from one another by less than their length; typically, head dark reddish-brown to black, mesosoma and legs orange to light brown, gaster dark brown..... ***C. scotti*** **McArthur**

31. With combination of strongly concave head capsule, many erect setae on sides and front of head capsule and propodeum steeply declivitous..... ..... ***C. discors*** **complex. sp. JDM 1104**

    Without this combination of characters..... ..... **32**

32. In full-face view, sides of head with erect setae along much of their length; sides of head more-or-less straight (*C. claripes* species-complex) (Figure 232) **33**

    In full-face view, sides of head without erect setae or with erect setae restricted to lower frons and genae; sides of head often convex (e.g. Figure 233)..... **37**

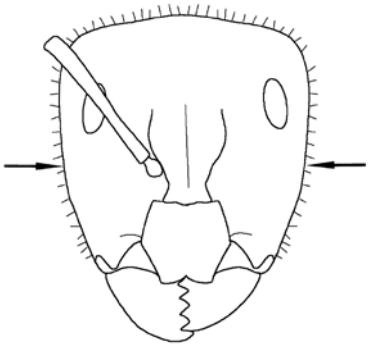

Figure 232

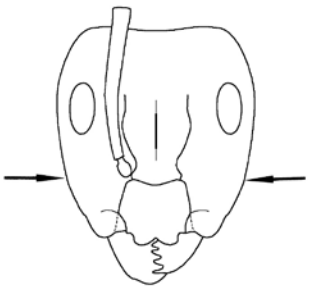

Figure 233

33. In profile, dorsum of propodeum straight, ratio of length of dorsum of propodeum to its declivitous face slightly more than 1:1 (Figure 234); mesosoma reddish contrasting with black head and gaster..... ..... ***C. claripes*** **complex sp. JDM 430**

    In profile, dorsum of propodeum convex, ratio of length of dorsum of propodeum to its declivitous face less than 1:1 (Figure 235); mesosoma not coloured as above..... ..... **34**

Figure 234

Figure 235

34. In dorsal view, gaster bicoloured, first tergite orange, remaining tergites dark brown to black..... ***C. marcens*** **Forel**

    In dorsal view, gaster concolorous dark brown to black..... **35**

35. Tibiae and much of femora same colour as mesosoma .... ***C. claripes*** **complex sp. JDM 779**

    Tibiae and femora much lighter than mesosoma **36**

36. Propodeum with few (10 ≤) erect setae clustered around propodeal angle; genae often with lighter-coloured regions (two or more species may well be represented here)..... ..... ***C. claripes*** **Mayr**

Propodeum with many (10>) erect setae descending up its dorsal face; genae without lighter-coloured regions ..... ***C. claripes* complex sp. JDM 767**

37. Dorsum of mesosoma completely without erect setae ..... ***C. oetkeri* Forel**

Dorsum of mesosoma with a few to many pairs of erect setae **38**

38. Ant completely black; cuticle dull in appearance ..... ***C. tristis* Clark**

Ant not completely black, appendages, at least, coloured; cuticle usually shining in appearance 39

39. Bright, glossy orange; five mandibular teeth; sculpture a fine microreticulation..... ***Camponotus* sp. JDM 1038**

Colour not bright, glossy orange; other features vary with species **40**

40. Head and gaster black; mesosoma and legs brick-red ..... ***C. armstrongi* Wheeler**

Not distinctly bicoloured as above (head and mesosoma yellow to black, with or without mottling, legs rarely red) **41**

41. Sides of head below eyes and lower genae with sparse to moderately abundant erect setae (Figure 236) **42**

Sides of head below eyes and lower genae lacking erect setae (Figure 237)..... ..... **46**

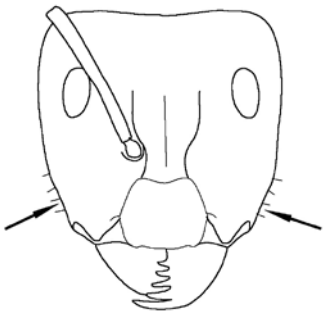

Figure 236

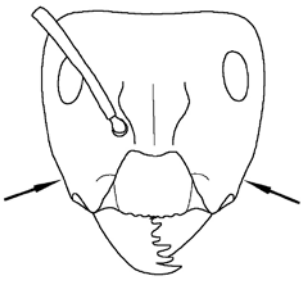

Figure 237

42. Very small species (HW ≤ 1.5 mm)..... ..... ***C. scratius* Forel**

Species larger (HW ≥ 2 mm)..... **43**

43. Clypeus with distinct anteromedial notch (glossy, black ants) (Figure 238) **44**

Clypeus without distinct anteromedial notch (either ants not black, or appearance matt) (Figure 239) **45**

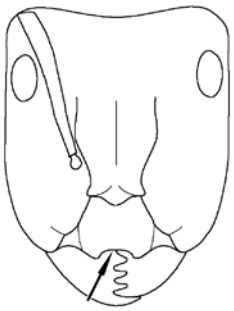

Figure 238

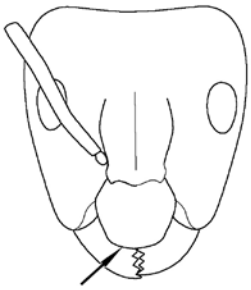

Figure 239

44. Sides of head parallel (Figure 240)..... ..... ***C. lownei* Forel**

Sides of head convex (Figure 241) .... ***C. evae zeuxis* Forel**

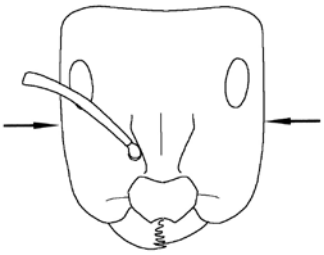

Figure 240

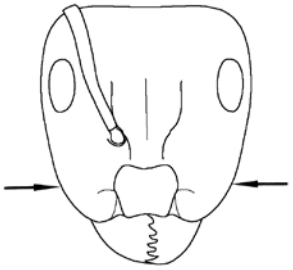

Figure 241

45. In full-face view, appearance of head of ant micropunctate, matt, black in colour .....
.....***C. oetkeri voltai*** **Forel**

In full-face view, appearance of head of ant more-or-less smooth, glossy, brown in colour.
.....***C. cowlei*** **Froggatt**

46. Clypeus rugose, matt, with strong pitting on its surface and on surrounding genae, clypeus flattened in profile (Figure 242) .....
..... ***C. claripes*** **group sp. JDM 288**

Clypeus smooth, shining, at most with only minor pitting on its surface and on surrounding genae, clypeus usually slightly protuberant in profile (Figure 243).....
..... **47**

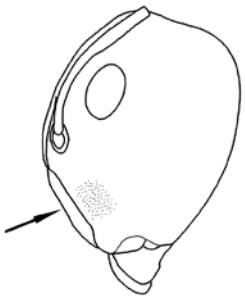

Figure 242

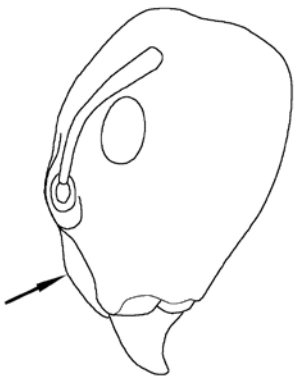

Figure 243

47. Bicoloured or pale species with ochre highlights on mesosoma, at least..... **48**

More-or-less uniformly black or blackish-brown species with pale legs..... **51**

48. Head much darker than mesosoma; anteromedial clypeal margin with a weak notch; vertex of head capsule weakly concave .....
.....***C. claripes nudimalis*** **Forel**

Either head the same colour as mesosoma, or only slightly darker, or anteromedial clypeal margin straight or crenulate, without notch, or vertex of head capsule markedly concave...
..... **49**

49. Anteromedial margin of clypeus with notch; head ochre, contrasting with dark brown mesosoma and gaster.....
.....***C. claripes minimus*** **Crawley (pt.)**

Anteromedial margin of clypeus without notch, though may be crenulate; head not lighter than mesosoma **50**

50. In full-face view, lateral sectors of clypeus strongly indented with central clypeal sector prominent, standing out in relief; external margin of mandible more-or-less uniformly rounded (minor workers with 8≥ mandibular teeth) (Figure 244) .....
..... ***C. claripes*** **group sp. JDM 63**

In full-face view, lateral sectors of clypeus only weakly indented, the central clypeal sector not prominent or standing out in relief; mandible triangular, its external margin oblique, only rounded in its apical quarter (minor workers with 6 mandibular teeth) (Figure 245) .....
..... ***C. discors*** **Forel/*C. gibbinotus*** **Forel**

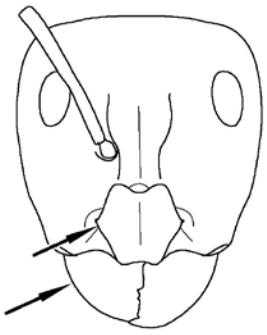

Figure 244

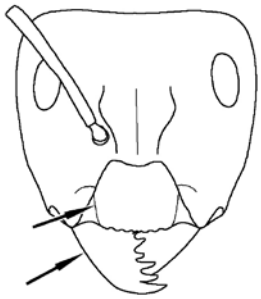

Figure 245

51. Larger species (HW ≈ 4 mm); in profile, metanotal groove a distinct notch (Figure 246) .....
..... ***C. michaelseni*** **Forel/*C. tumidus*** **Crawley**

Smaller species (HW ≤ 3 mm); in profile metanotal groove indistinct or a small dimple (Figure 247) **52**

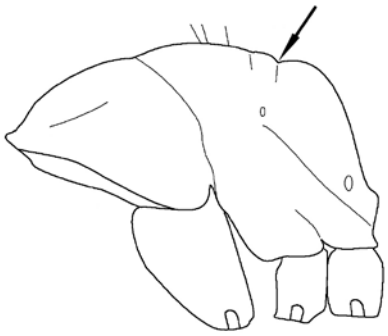

Figure 246

Figure 247

52. Setae on venter of head capsule present .... ***C. walkeri*** **Forel**

    Setae on venter of head capsule absent **53**

53. In full-face view, anteromedial clypeal margin with a weak notch, head triangular, expanded towards angles of vertex .... ***C. claripes minimus*** **Crawley (pt.)**

    In full-face view, anteromedial clypeal margin either without notch, or head not triangular... ..... **54**

54. In full-face view, mandibles short, compact, with five teeth (Figure 248) .... ***C. simpsoni*** **McArthur**

    In full-face view, mandibles of normal appearance, with six teeth or five strong teeth and additional denticle (Figure 249) .... ***C. darlingtoni*** **Wheeler**

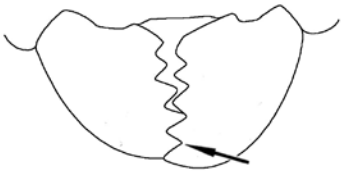

Figure 248

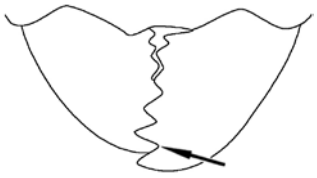

Figure 249

Minor workers

1. Inner surfaces of middle and hind tibiae lacking elongate setae (Figure 186a); frontal carinae width usually > 1/2 HW (slightly less than 1/2 HW in *C. macrocephalus* group sp. JDM 927) (Figure 250); (*macrocephalus* species-group)..... ..... **2**

    Inner surfaces of middle and hind tibiae with double row of stout bristles (Figure 187a); frontal carinae width <1/2 HW (Figure 251);... ..... **3**

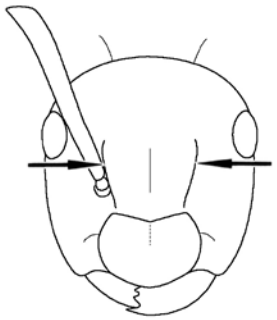

Figure 250

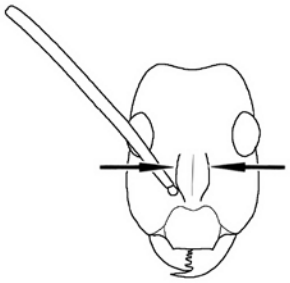

Figure 251

2. Mesosoma and node without erect setae or pubescence; venter of head capsule without erect setae; in profile, protuberances on dorsum of mesosoma smoothly rounded; propodeal spiracle near midpoint of propodeum (Figure 252) .... ***C. gasseri*** **(Forel)**

    Mesosoma and node pubescent, erect setae on all body surface; a few erect setae on venter of head capsule; protuberances on dorsum of mesosoma rather angulate in outline; propodeal spiracle near declivitous face of propodeum (Figure 253) ..... ***Camponotus macrocephalus*** **group sp. JDM 927**

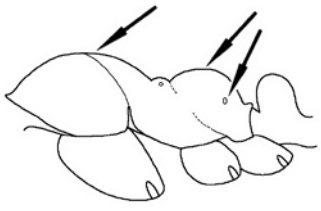

Figure 252

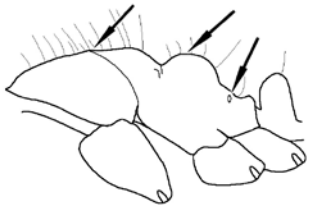

Figure 253

3. Mentum with elongate, J-shaped setae near its posterior margin (Figure 188) (*C. wiederkehri* species-group) **4**

   Without elongate J-shaped setae on posterior margin of mentum (Figure 189)..... **15**

4. Head capsule strongly tapered posteriad, with fluted edges around foramen (Figure 254)..... .....***C. johnclarki*** **Taylor**

   Head capsule rounded in normal way posteriorly (Figure 255) **5**

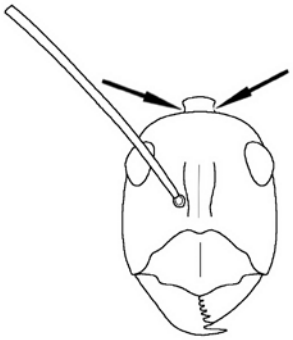

Figure 254

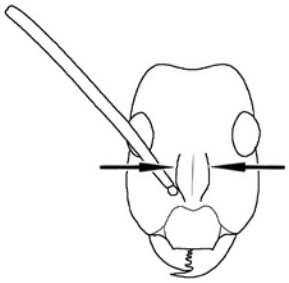

Figure 255

5. Surfaces of tibiae and antennal scape with many erect, bristly setae (Figure 256a, b) **6**

   Surfaces of tibiae and antennal scape lacking erect, bristly setae (Figure 257a, b)..... **7**

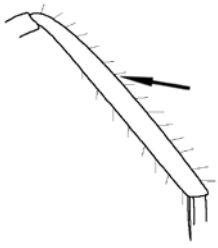

Figure 256a

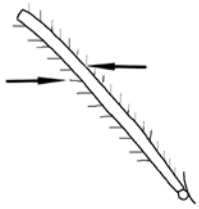

Figure 256b

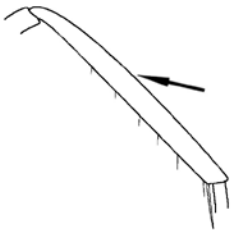

Figure 257a

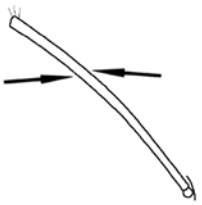

Figure 257b

6. In profile, petiolar node thick, about as high as wide, pubescence on head and gaster abundant, individual setae overlapping (Figure 190b) ..... ***C. gouldianus*** **Forel**

   In profile, petiolar node thinner, about twice as high as wide; pubescence on gaster less abundant, individual setae usually not overlapping (Figure 191b).....***C. terebrans*** **(Lowne)**

7. Metanotal groove strongly impressed, rising abruptly at commencement of propodeum (Figure 258a); petiolar node elongate, flattened, with anterior face much shorter than posterior face (Figure 258b) ..... ***C. versicolor*** **Clark**

   Metanotal groove, at most, only weakly to moderately impressed (e.g. Figures 259a, 260, 261), in such cases not rising abruptly with commencement of propodeum; petiolar node variable but not normally elongate and vertex often distinctly convex, its anterior face only slighter shorter than its posterior face (Figure 259b) **8**

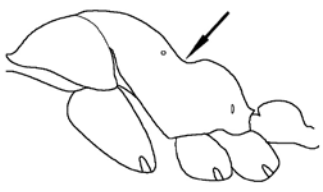

Figure 258a

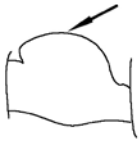

Figure 258b

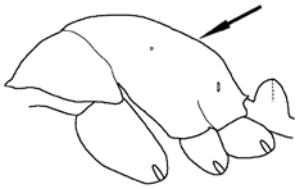

Figure 259a

Figure 259b

8. Angles of vertex acute; ant with 'hump-backed' appearance (Figure 192) ..... ***C. postcornutus* Clark**

   Angles of vertex rounded; dorsum of mesosoma gently to moderately sinuate (e.g. Figure 193).. ..... **9**

9. Metanotal groove visibly impressed, propodeum distinctly convex (Figure 260); first gastral tergite may be lighter in colour than remaining tergites..... **10**

   Metanotal groove vestigial or absent, propodeal dorsum straight or barely convex (Figure 261); first gastral tergite concolorous with remaining tergites..... **11**

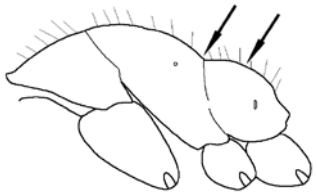

Figure 260

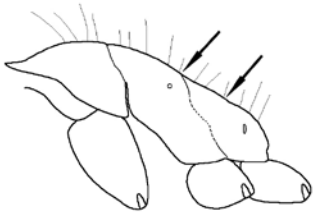

Figure 261

10. In full-face view, setae on the lower sides of head capsule lacking; head and mesosoma red (Figure 262) ..... ***C. wiederkehri* group sp. JDM 924**

    In full-face view, head capsule with many erect setae around its perimeter; head and mesosoma orange (Figure 263) ..... ***C. wiederkehri* group sp. JDM 925**

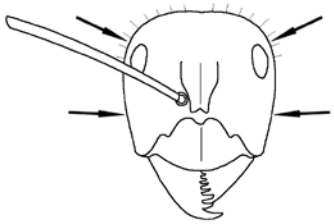

Figure 262

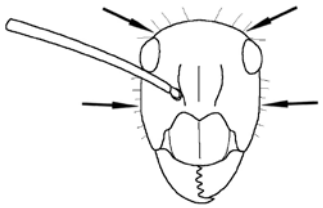

Figure 263

11. Eye larger, eye length about 1/4 length of head capsule (Figure 264) ..... ***C. wiederkehri* Forel**

    Eye smaller (eye length 1/5 ≤ head length) (Figure 265) (ants in *C. ceriseipes* complex) **12**

Figure 264

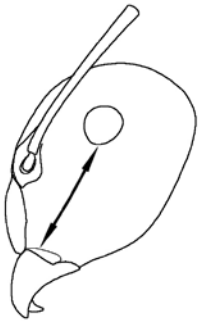

Figure 265

12. Viewed from behind, appressed setulae on one side of gaster gradually converging towards centre of gaster, without clear central line of demarcation (Figure 266) ..... ***C. ceriseipes* complex sp. JDM 105**

Viewed from behind, appressed setulae on one half of gaster the mirror image of appressed setulae on the other half, the two sides meeting in a clear line of demarcation (most noticeable on tergites 2–4) (Figure 267)..... ..... **13**

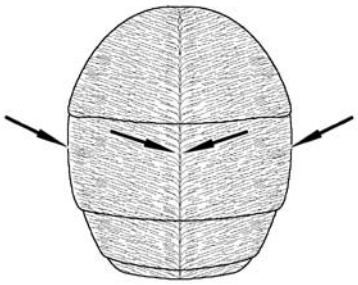

Figure 266

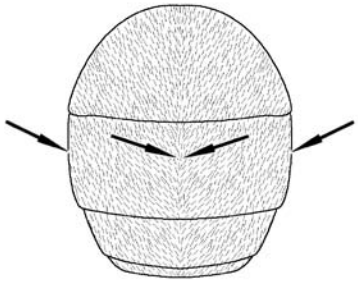

Figure 267

13. Erect setae sparse on mesosoma, on propodeum 4 ≤, clustered on or near propodeal angle..... ..... ***C. donnellani*** **Shattuck and McArthur**

Erect setae abundant on mesosoma, on propodeum 4 >, arranged along length of sclerite..... **14**

14. Scapes relatively shorter (SI < 150); petiolar node often tending to rectangular in profile, rounded above and inclined anteriad ....***C. ceriseipes*** **Clark**

Scapes relatively longer (SI > 150); petiolar node often tending to tumular in profile, rounded above and inclined anteriad..... ..... ***C. prosseri*** **Shattuck and McArthur**

15. Clypeus concave or with anteromedial notch; clypeus projecting beyond genae, clypeal angles acute or right-angled (*C. nigriceps* species-group) (Figure 200) **16**

Conformation of clypeus not as above..... ..... **20**

16. Setae on venter of head capsule absent (Figure 201)..... .....***C. longideclivis*** **McArthur and Adams**

Setae on venter of head capsule present (Figure 202) **17**

17. Dorsum of propodeum with 10 > erect setae, setae distributed over propodeum (Figure 203) **18**

Dorsum of propodeum with 10 < erect setae at or near propodeal angle (Figure 204)..... **19**

18. Head, mesosoma, node and most of gaster uniformly honey coloured..... ***C. clarior*** **Forel**

Head black or brown, mesosoma yellow or red-brown..... ***C. nigriceps*** **(F. Smith)**

19. Erect setae on venter of head capsule 20 >, or setae covering more than 1/2 venter area (Figure 205); typically, head dark brown or black, mesosoma yellowish to dark red and gaster brown or black, with or without yellowish colouration anteriad ....***C. dryandrae*** **McArthur and Adams**

Erect setae on venter of head capsule 20 <, or setae covering less than 1/2 venter area (Figure 206); typically, head, mesosoma and gaster concolorous dark brown or black ....***C. prostans*** **Forel**

20. Head capsule behind eyes strongly attenuated, the edges of the foramen fluted or flanged (Figure 268a, b); number of mandibular teeth usually 7 or more (*C. subnitidus* species-complex) **21**

Head capsule behind eyes not strongly attenuated, the edges of the foramen normal (Figure 269a, b); number of mandibular teeth often 5 or 6. ..... **22**

Figure 268a

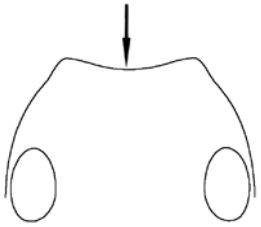

Figure 268b

Figure 269a

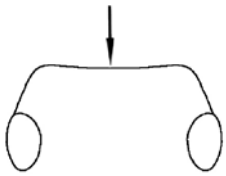

Figure 269b

21. Setae on venter of head capsule absent; number of mandibular teeth 9, mesosoma reddish-brown..... ***C. rufus*** **Crawley**

    Setae on venter of head capsule present; number of mandibular teeth 7 or 8, mesosoma ochre to brown ..... ***C. tricoloratus*** **Clark**

22. Body and appendages covered with short, white, erect setae; pubescence lacking on head, gaster and most of mesosoma; number of mandibular teeth 7; clypeus projecting, its anterior margin straight, without central notch or depression ....***C. molossus*** **Forel**

    Body and appendages rarely covered with short, white, erect setae; if many white, erect setae present, then differing in one or more of the other characters..... **23**

23. Metanotal groove deeply impressed, the propodeum quadrate (Figure 270); sculpture of head and mesosoma densely microreticulate-foveate.....***C. whitei*** **Wheeler**

    Metanotal groove weakly impressed or obsolete, propodeum not quadrate..... **24**

24. Combination of 9 or 10 mandibular teeth, gracile body and elongate head capsule that is moderately attenuated behind large compound eyes (Figure 271)..... ..... ***C. claripes*** **group sp. JDM 63**

    Number of mandibular teeth usually 8 ≤; if 7 or more, then head capsule not as above, usually square, often with vertex broad and somewhat flattened..... **25**

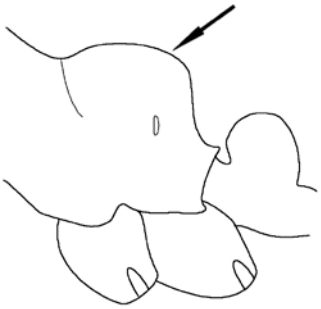

Figure 270

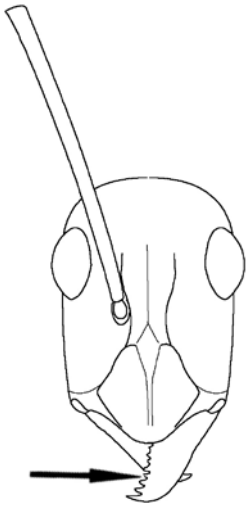

Figure 271

25. Propodeum with a transverse notch about midpoint of its dorsal face (Figure 272) ....***Camponotus*** **sp. JDM 26**

    Propodeum without transverse notch (Figure 273) **26**

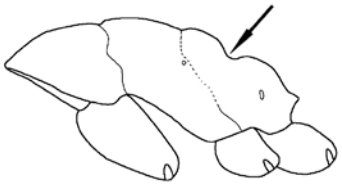

Figure 272

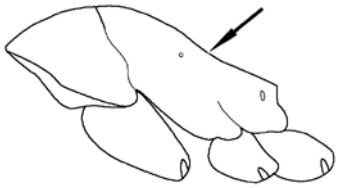

Figure 273

26. Number of mandibular teeth nearly always 7 or 8, very rarely 6 or 9 teeth on one or both mandibles (in which case mesosoma is distinctly concave in profile), mesosoma with concavity or angle at metanotal groove, or propodeum concave; head often square with eyes set at or near angles of vertex (Figures 274); body often densely hairy or with thick

pubescence (*C. ephippium* species-complex) (Figure 275) **27**

Number of mandibular teeth 5 or 6; in profile, dorsum of mesosoma often strongly convex, dorsum of propodeum may have a distinct concavity or 'saddle' in a few species, but usually convex or straight in outline; vertex of head capsule often strongly convex with eyes set well below vertex (taxa with flattened vertex or with angle between vertex and sides of head capsule usually have 5 teeth and a strongly convex propodeal dorsum in profile); body rarely with thick pubescence **38**

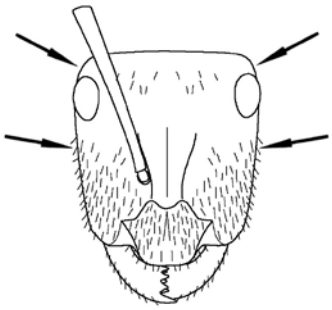

Figure 274

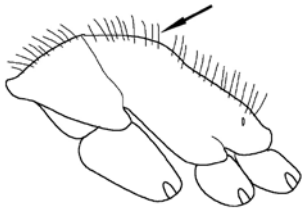

Figure 275

27. In profile, vertex of head capsule tapered to a blunt angle; body with pinkish iridescence (appearance that of a meat ant (*Iridomyrmex purpureus* group)) (Figure 276)..... ..... ***C. perjurus* Shattuck and McArthur**

In profile, vertex of head capsule not tapered to a blunt angle, pinkish iridescence lacking, appearance not meat-ant like **28**

28. Small species (HW ≤ 1 mm)..... **29**

Species larger (HW ≥ 1.5 mm) **30**

29. Non-gracile species; in full-face view, head capsule almost as wide as long; clypeus projecting forward, its anteromedial clypeal margin straight (Figure 277) .... ***C. sponsorum* Forel**

Gracile species; in full-face view head capsule less than two thirds as wide as long; anterior margin of clypeus strongly and evenly convex (Figure 278) ....***C. longifacies* McArthur**

Figure 276

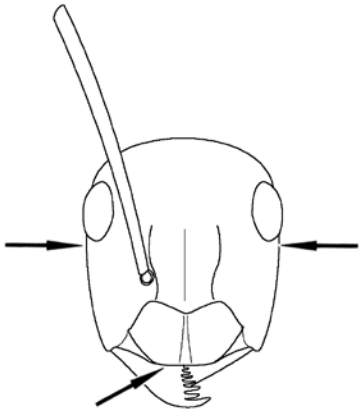

Figure 277

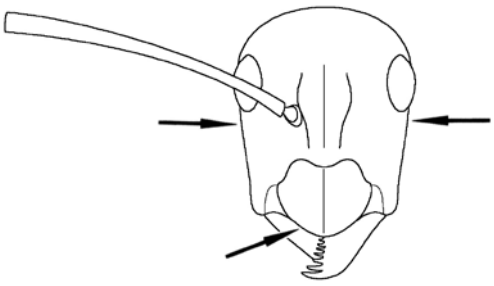

Figure 278

30. Vertex convex, without distinct separation between vertex and sides of head capsule; eyes placed somewhat below level of dorsum of vertex (Figure 279)..... **31**

Vertex flat or nearly so, vertex and sides of head capsule may be separated by angle; eyes placed at or near dorsum of vertex (Figure 280) **33**

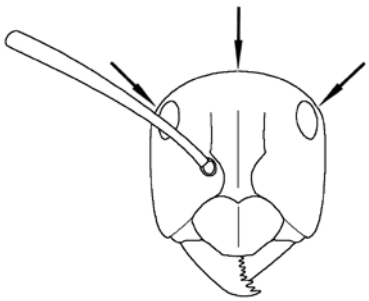

Figure 279

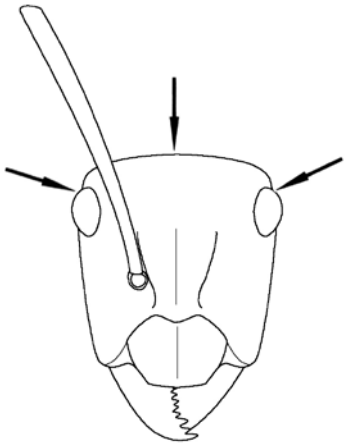

Figure 280

31. Tibiae (Figure 281a) and antennal scape (Figure 281b) (and rest of body) covered with many long, erect, white setae ..... ***C. pawseyi*** **McArthur**

    Tibiae (Figure 282) and antennal scape (Figure 283), at least, lacking long, erect, white setae **32**

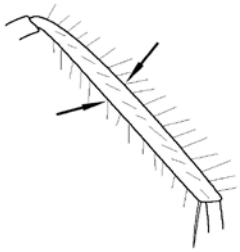

Figure 281a

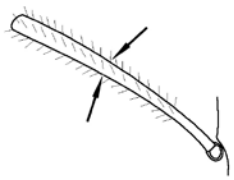

Figure 281b

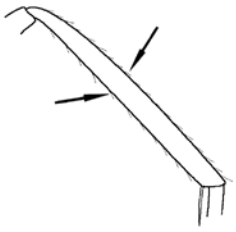

Figure 282

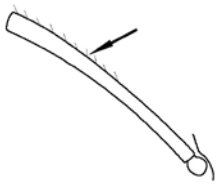

Figure 283

32. Tibial setae raised to angle of about 20° (Figure 284); in full-face view sides of head with very many erect, white setae; antennal scape often with several semi-erect setae ..... ***C. cinereus notterae*** **Forel (pt.)**

    Tibial setae appressed or barely raised (Figure 285); in full-face view, sides of head with fewer (usually 12≤), erect, white setae; antennal scape lacking semi-erect setae ..... ***C. ephippium complex*** **sp. JDM 775**

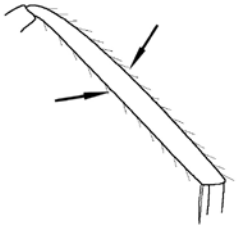

Figure 284

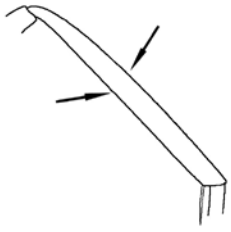

Figure 285

33. Tibial setae raised to angle of 20°, giving leg of ant a shaggy appearance (Figure 284) **34**

    Tibial setae appressed or barely raised (Figure 285) **36**

34. With combination of vertex of head completely flattened, with blunt angle distinctly separating dorsum of head from its sides (Figure 280) and antennal scape with several longer, erect or semi-erect setae..... ***Camponotus*** **near** ***ephippium*** **(F. Smith) sp. JDM 431**

    Either vertex of head not so flattened, without distinct separation of dorsum and sides (Figure 279), or antennal scape lacking several longer, erect or semi-erect setae except at the end..... **35**

35. In full-face view, vertex of head behind eyes slightly convex, narrowed towards occiput, eyes set just below posterior angles of vertex (Figure 286); sides of head with many erect setae; ant black or black-and-red in colour with orange mid and hind femora, femora black distally..... ***C. cinereus notterae*** **Forel (pt.)**

In full-face view, vertex of head behind eyes flattened, truncated, not narrowed towards occiput, eyes set at posterior angles of vertex (Figure 287); sides of head usually with few erect setae; colour various but legs not as above.....*C. ephippium* **(F. Smith)**

Figure 286

Figure 287

36. Individual minute setulae comprising pubescence linked together in rows, giving feathery appearance to each cluster, thick and overlapping on clypeus (Figure 288).....
.....*C. dromas* **Santschi**

Individual setulae comprising pubescence distinct, less abundant and non-overlapping on clypeus (Figure 289) **37**

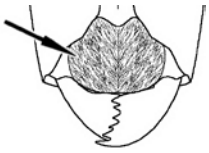

Figure 288

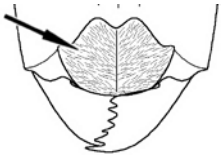

Figure 289

37. Appressed setae on body minute, sparse; those on gaster well-separated; nearly always black with red head (very rarely, head and mesosoma reddish-orange, gaster black, or ant entirely black).....
..*C. capito ebenithorax* **Forel ("black soma")**

Appressed setae on body longer, more abundant; those on anterior of gastral tergites overlapping, forming whitish pubescence; colour variable, often red, or red and dark red, but not distinctly bicoloured as above.....
..... *C. capito ebenithorax* **Forel**

38. Very small (HW ≤ 1 mm); body very compact, in profile, pronotum slightly convex anteriorly, otherwise dorsum of mesosoma almost straight; in profile, propodeal angle produced as a broad, bluntly rounded shelf overhanging the node, declivitous face of the propodeum deeply concave (Figure 290); sculpture densely foveate; body and appendages orange to dark reddish-orange .....
.....*Camponotus* **sp. JDM 695**

If appearance generally as above, in profile, propodeal angle not produced to form a blunt shelf overhanging a deeply impressed declivitous propodeal face..... **39**

39. Gaster black with yellowish-green sheen, finely microreticulate, the cells even and impressed; cuticular membrane at apex of each tergite yellowish; head and mesosoma finely sculptured, black or black-and-red with faint white or yellowish sheen; propodeum long, barely to moderately concave (in latter case forming a 'saddle'); in rear view, sides of mesopleuron and propodeum not or barely compressed; legs red to dark reddish-brown (*C. nigroaeneus* complex, pt.) **40**

Appearance of gaster not as above; otherwise often differing in one or more characters .....
..... **43**

40. Pronotum and mesonotum black, propodeum and posterior of metapleuron bright crimson .
..... *C. chalceus* **Crawley**

Colour combination of mesosoma not as above ..
..... **41**

41. In profile, dorsum of propodeum moderately concave, the propodeal angle raised, forming a small hump.....
.....*C. nigroaeneus* **complex sp. JDM 1031**

In profile, dorsum of propodeum not or barely concave, the propodeal angle not raised .....
..... **42**

42. In full-face view, vertex of head slightly concave, sides of head moderately convex (Figure 291) .
..... *C. hartogi* **Forel**

In full-face view, vertex of head moderately convex, sides of head more-or-less straight (Figure 292) .....*C. innexus* **Forel**

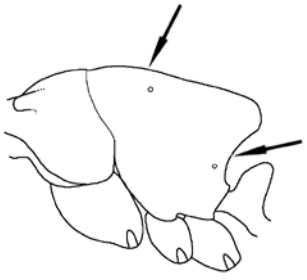

Figure 290

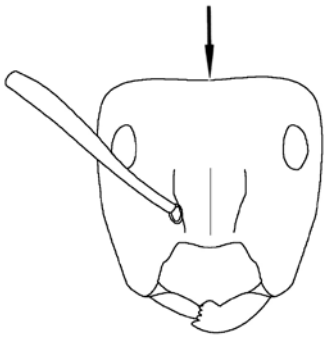

Figure 291

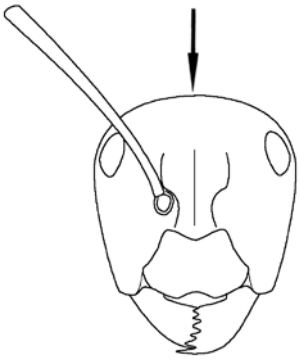

Figure 292

43. Declivitous face of propodeum steep, long (ratio between length of dorsum of propodeum and its declivitous face much less than 1:1, often 1:2–1:3) (Figure 293); viewed from rear, sides of propodeum strongly laterally compressed and tapering to a blunt to sharp edge posteriad (Figure 294); sculpture of mesopleuron and propodeum consisting of evenly impressed microreticulation; body concolorous black or dark brown, legs often light in colour; number of mandibular teeth usually six, rarely five (e.g. in some specimens of *C. tristis*) **44**

    If declivitous face of propodeum steep and long, then propodeal sides not tapering to blunt or sharp edge or body colour not concolorous black (members of *C. lownei* complex, which are similar, always have five mandibular teeth, the propodeal flanks are less compressed; the mesopleural and propodeal microsculpture is superficial without uniform, impressed microreticulation, and the colour may be brown, reddish or bicoloured shades of brown or red-and-black) **48**

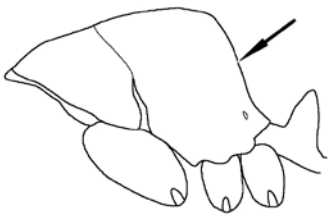

Figure 293

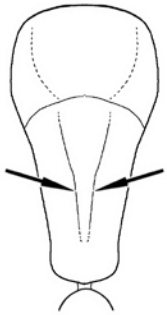

Figure 294

44. Erect setae completely absent from dorsum of mesosoma ..... ***C. oetkeri*** **Forel**

    At least two pairs of erect setae present on mesosoma **45**

45. Ant completely black, dull in appearance; propodeal angle not distinct ..... ***C. tristis*** **Clark**

    Ant with femora, at least, normally lighter coloured than the body (usually yellow or reddish), if femora dark, then ant with relatively sharp propodeal angle (rare *C. michaelseni* workers); usually shining in appearance **46**

46. Dorsum of mesosoma with more than three pairs of erect setae (usually many); pronotum and mesonotum distinctly shagreenate in appearance ..... ***C. evae voltai*** **Forel**

    Dorsum of mesosoma with 2 or 3 pairs of erect setae; sculpture on pronotum and mesonotum very weak, these sclerites shiny in appearance **47**

47. Femora yellowish (rarely dark brown), tibiae brown; propodeal angle distinct (Figure 295) ..... ***C. michaelseni*** **Forel**/***C. tumidus*** **Crawley**

    Legs uniformly light brown to yellowish; propodeal angle indistinct (Figure 296) ..... ***C. walkeri*** **Forel**

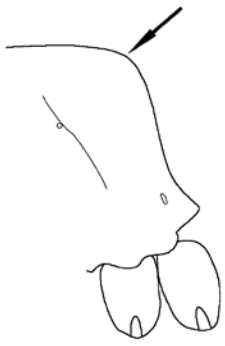

Figure 295

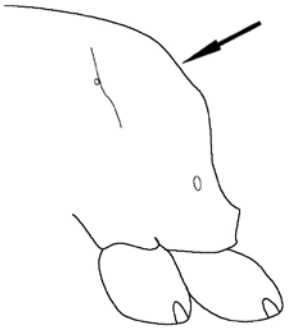

Figure 296

48. Five mandibular teeth (basal (sixth) tooth may be represented by minute denticle or angle); in profile, pronotum flat, metanotal groove obsolete; propodeum usually steeply declivitous (Figure 297)..... **49**

Six distinct mandibular teeth; profile usually different (e.g. Figure 298) **58**

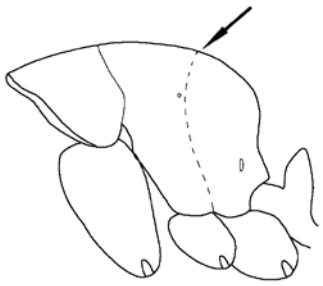

Figure 297

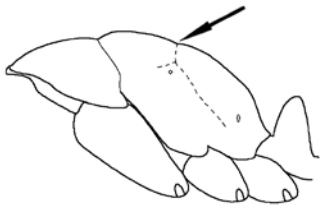

Figure 298

49. Head and at least pronotum and mesonotum of mesosoma densely foveate-punctate; matt in appearance, colour of body and appendages orange **50**

Head and mesosoma usually shining, either smooth or with microsculpture; if matt in appearance and reddish, then sculpture finely shagreenate; most commonly black or dark brown with lighter appendages (*C. lownei* complex) or mottled or concolorous ochre (some populations of *C. gibbinotus*) **51**

50. Head and mesosoma densely foveate-punctate (Figure 299); very many erect setae on body, femora and antennal scape; matt in appearance ..... ***Camponotus* sp. JDM 771**

Sculpture and appearance generally as above, but dorsum and sides of propodeum with fine, parallel striolae rather than fovea or punctures (Figure 300); femora and antennal scape lacking erect setae, except at the ends ... ***Camponotus* sp. JDM 1038**

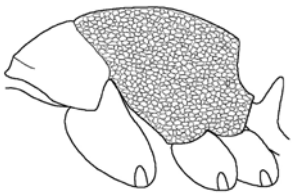

Figure 299

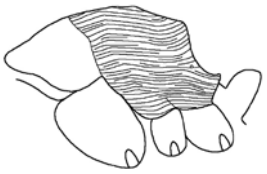

Figure 300

51. Propodeal angle absent or very weak, dorsum of propodeum rounding smoothly into declivitous surface of propodeum (Figure 301) **52**

Propodeal angle present, dorsum and declivitous face of propodeum distinctly separate (Figure 302) **54**

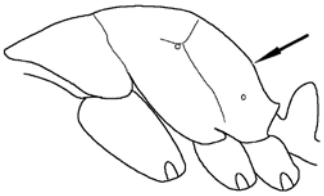

Figure 301

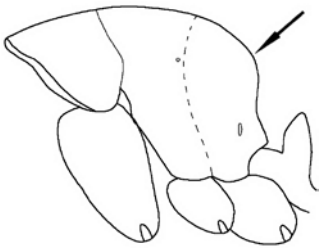

Figure 302

52. Uniformly pale ochraceous; basal (sixth tooth) may be represented by a minute half denticle or angle; seen from rear propodeum strongly laterally compressed with distinct edge..... ***C. gibbinotus* Forel (pt)**

Head much darker than mesosoma when ant viewed dorsally, or ant uniformly dark brownish or black; five mandibular teeth; seen from rear propodeum only moderately laterally compressed without distinct edge..... **53**

When viewed full-face, head capsule rectangular, eyes placed well below vertex (Figure 303)..... .....***C. discors* complex sp. JDM 772**

When viewed full-face, head capsule square, eyes placed near vertex (Figure 304)..... ..... ***C. lownei* complex sp. JDM 616**

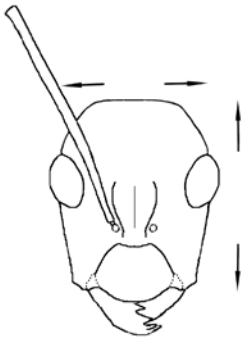

Figure 303

Figure 304

54. Head and gaster black, mesosoma, node and legs bright reddish-brown..... ..... ***C. armstrongi* McAreavey**

Head and body either concolorous reddish-or-orange-brown or blackish-brown to black..... ..... **55**

55. Underside of head with several erect setae **56**

Underside of head lacking erect setae..... **57**

56. Mandible concolorous reddish-brown; appendages ochre to rich reddish-brown; in full-face view, margin of vertex of head capsule flat to slightly concave in many specimens..... ***C. lownei* Forel**

Mandible dark brown to black with transverse lighter band of colour near masticatory margin; appendages dark brown to brownish-black; in full-face view, margin of vertex of head capsule tending to slightly convex (n.b. Caution: the distinctions between *C. lownei* and *C. evae zeuxis* minor workers given here may not be true for all populations. Major workers are required for a definitive diagnosis) ..... ***C. evae zeuxis* Forel**

57. Vertex of head capsule with erect and semi-erect setae scattered over dorsum; abundant semi-erect setae present on legs and antennae, these setae set at ≈ 20° to horizontal plane (Figure 305a,b) .... ***C. simpsoni* McArthur**

Erect setae on dorsum of vertex of head capsule confined to a paired row that straddle the midline of the head capsule; setae on antenna and legs appressed or nearly so (Figure 306a,b) ..... ***C. lownei* complex sp. JDM 761**

Figure 305a

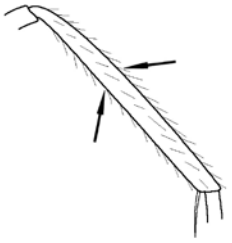

Figure 305b

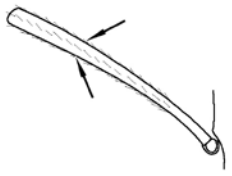

Figure 306a

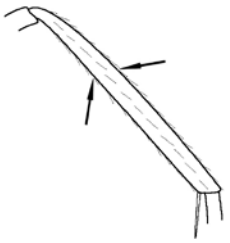

Figure 306b

58. In profile, mesosoma forming an arc, mesonotum and propodeum, at least, strongly convex (Figure 307a); in dorsal view, mesonotum and propodeum broad, not laterally compressed (Figure 307b); Vertex of head capsule flat, with distinct angle between eye and posterior margin of head capsule (Figure 307c) ....***C. arcuatus* complex sp. JDM 694**

In profile, mesosoma not forming an arc, either pronotum and mesonotum flattened, propodeum sharply declivitous towards its junction with the petiole, or mesosoma

weakly convex, the propodeum weakly convex or straight; in dorsal view, propodeum often distinctly laterally compressed (Figure 308); head capsule usually without distinct angle between eye and posterior margin of head capsule (Figure 309) **59**

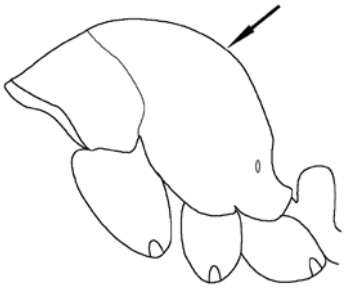

Figure 307a

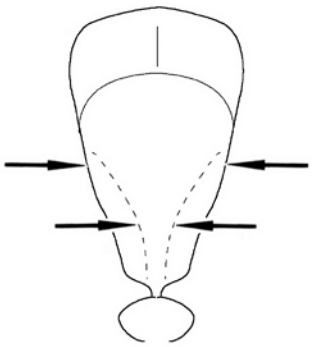

Figure 307b

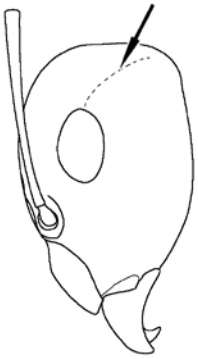

Figure 307c

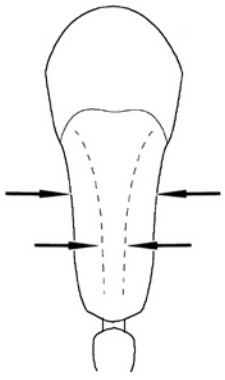

Figure 308

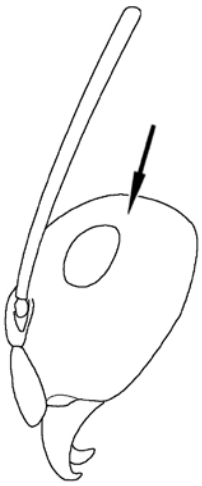

Figure 309

59. In full-face view, setae on sides of head extending above level of eyes; antennal scape with short erect and sub-erect setae (Figure 310)..... **60**

In full-face view, setae on sides of head not extending above level of eyes, either absent or restricted to a few about articulation of mandibles (except for *C. cowlei*); antennal scape often lacking erect setae, where present these confined to one or two (Figure 311) **61**

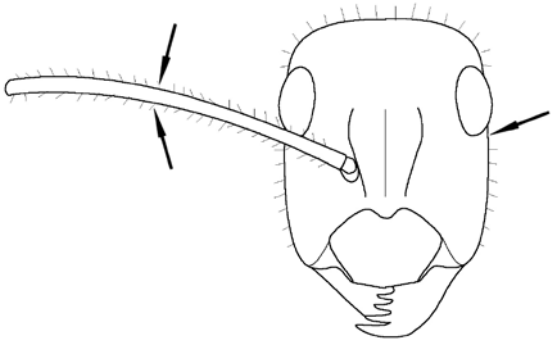

Figure 310

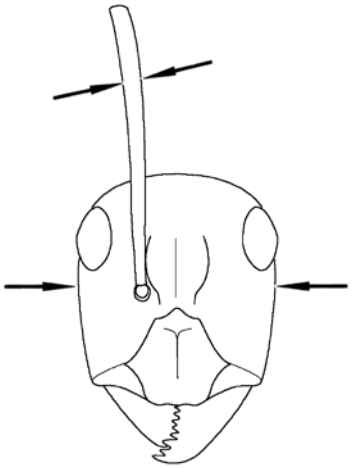

Figure 311

60. Head black, contrasting with tawny-orange mesosoma; in full-face view, anteromedial clypeal margin straight without small protuberance at midpoint (Figure 312) ..... ***C. claripes* complex sp. JDM 767**

Head concolorous or only slightly darker than tawny-orange mesosoma; in full-face view, anteromedial clypeal margin slightly convex, with small protuberance at midpoint (Figure 313)..... .....***C. discors* complex sp. JDM 1104**

Figure 312

Figure 313

61. Erect pronotal setae consisting of one pair placed near the promesonotal suture (rarely, additional shorter erect setae may be found in some *C. darlingtoni* individuals) (Figure 314) **62**

Erect pronotal setae consisting of one pair placed at about midpoint of sclerite or of more than three setae without a pair placed near promesonotal suture (Figure 315)..... **64**

Figure 314

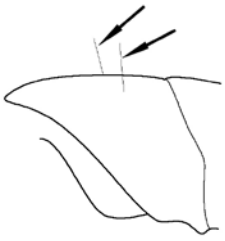

Figure 315

62. In profile, dorsal propodeal face straight, ratio of dorsal to declivitous propodeal face ≈ 2:1 (Figure 316)..... .....***C. darlingtoni* Wheeler**

In profile, dorsal propodeal face convex, ratio of dorsal to declivitous propodeal face 1:1–1:2 (Figure 317) **63**

Figure 316

Figure 317

63. Setae on venter of head capsule present (mainly SW coastal plain, also found on inland sand-plains) ..... ***C scratius* Forel**

Setae on venter of head capsule absent (widespread) .... ***C. claripes minimus* Crawley**

64. Body and appendages bright yellow-orange, last two tergites of gaster blackish..... .....***C. claripes marcens* Forel**

Colour variable, but never as above..... **65**

65. In profile, dorsum of propodeum straight; in rear view, sides of propodeum not compressed or very weakly so (Figure 318)..... **66**

In profile, dorsum of propodeum weakly to strongly convex, arcing down to propodeal angle; in rear view sides of propodeum strongly compressed (Figure 319)..... **69**

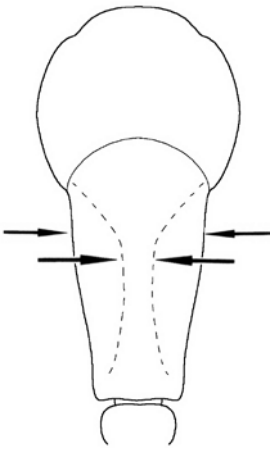

Figure 318

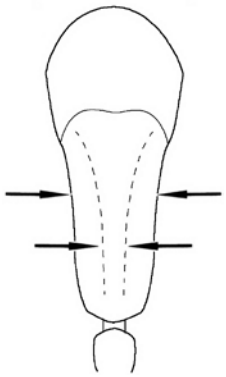

Figure 319

66. Setae present on venter of head capsule .... ***C. claripes*** **complex sp. JDM 430**

    Setae absent from venter of head capsule..... ..... **67**

67. Appressed setae relatively long, glistening and sometimes curled, forming close, irregular rows on head, mesosoma and gaster (Figure 320) ..... ***C. scotti*** **McArthur**

    Appressed setae minute, well-separated on gaster (Figure 321), forming fine pubescence on lower mesopleuron, propodeum and node **68**

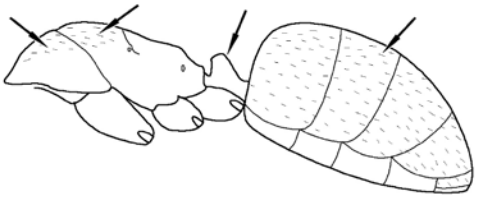

Figure 320

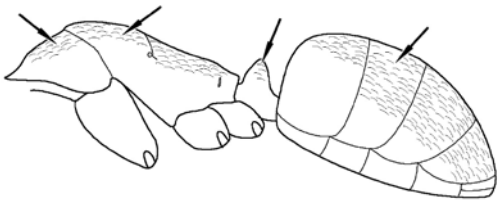

Figure 321

68. In full-face view, sides of head straight, parallel (Figure 322); mesosoma matt, shagreenate with milky sheen .... ***C. cinereus amperei*** **Forel**

    In full-face view, sides of head tapering, converging anteriad (Figure 323); mesosoma more shiny in appearance .... ***C. pitjantjatarae*** **McArthur**

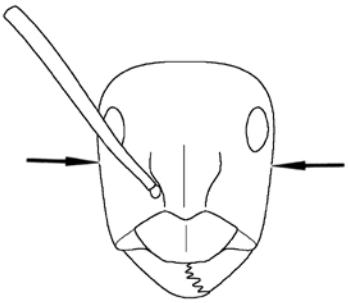

Figure 322

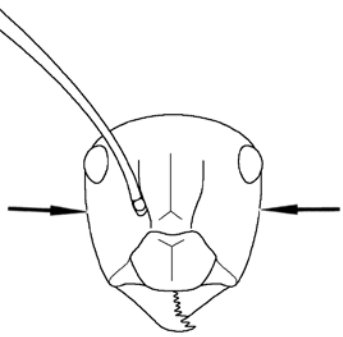

Figure 323

69. Appearance matt, dull, with fine, micropunctate sculpture; colour usually uniformly dingy, dark, greyish-brown, more rarely reddish-orange with greyish-brown gaster..... ..... ***C. claripes*** **complex sp. JDM 779**

    Appearance glossy, with only very superficial microsculpture; colour variable, but usually paler with at least some yellowish sectors..... ..... **70**

70. In full-face view, genae and lower sides of head capsule with several to many erect and sub-erect setae (Figure 324).....***C. cowlei*** **Froggatt**

    Genae without erect setae, usually also lacking from lower sides of head capsule (one or two very small erect setae may be present near mandibular insertion) (Figure 325)..... **71**

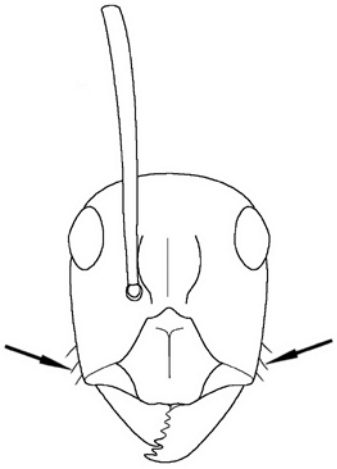

Figure 324

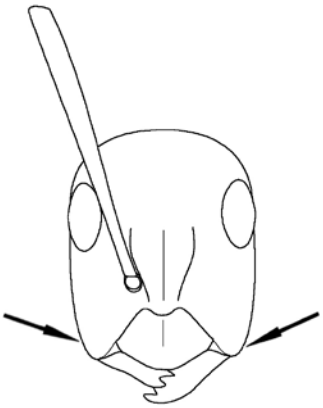

Figure 325

71. Anteromedial margin of clypeus straight or slightly emarginate (Figure 326); in profile, petiolar node usually thicker, its dorsum rounded, with tapering edge (if present) directed posteriad; ratio of length of dorsum of propodeum to its declivitous face 1:2≥..... ..... **72**

    Anteromedial margin of clypeus weakly convex, often with small protuberance at its midpoint (Figure 327); in profile, petiolar node rather high and thin, usually tapering to a sharp point apically; ratio of length of dorsum of propodeum to its declivitous face 1:1–1:2 .... **74**

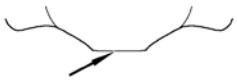

Figure 326

Figure 327

72. Head and body concolorous ochre to pale brown, legs uniform pale yellow; erect setae absent from venter of head capsule..... ..... ***C. claripes*** **group sp. JDM 288**

    Head conspicuously darker than mesosoma and/or legs with patches of grey infuscation or uniformly dark in colour; one to several erect setae nearly always visible on venter of head capsule **73**

73. Head broader (CI 75≥)..... .....***C. claripes nudimalis*** **Forel**

    Head narrower (CI 70 <)(possibly a complex of at least two species represented here)..... .....***C. claripes*** **Mayr**

74. Sides of head diverging anteriad, greatest head width near articulation of mandibles (Figure 328) ..... ***C. claripes*** **group sp. JDM 1073**

    Sides of head more-or-less parallel (Figure 329).. ..... **75**

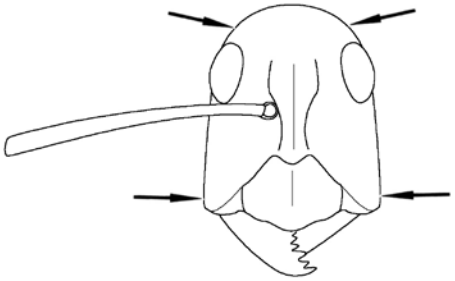

Figure 328

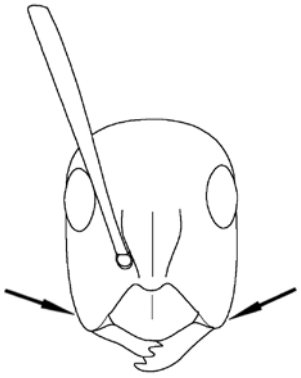

Figure 329

75. Setae on venter of head capsule (if present: absent in SWBP specimens, see Figure 330) confined to depression near foramen; yellowish, pale ants, head not darker than mesosoma ..... ***C. gibbinotus*** **Forel (pt.)**

    Setae on venter of head capsule covering a larger area (McArthur, pers. comm. – confined to foramen in SWBP specimens, see Figure 331); tawny-orange to brownish ants, head may be darker than mesosoma..... .....***C discors*** **Forel**

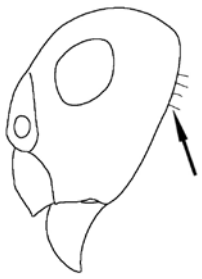

Figure 330

Figure 331

The lack of a metapleural gland will distinguish West Australian *Camponotus* from all other formicines, except for *Oecophylla* and *Polyrhachis*. *Oecophylla*, represented in Australia only by the famous green tree or weaver ant, *Oecophylla smaragdina* (Fabricius), does not occur in the SWBP, and in *Polyrhachis* spines or sharp angles are always present on the petiolar node (and usually the propodeum), and the first gastral tergite represents slightly less than half to more than half the total length of the gaster. In Australian *Camponotus* spines or sharp angles are lacking on the petiolar node, and the propodeum never carries spines. Moreover, the first gastral tergite represents much less than half the total length of the gaster. *Camponotus* workers are polymorphic, while those of *Polyrhachis* are monomorphic.

The genus *Camponotus* is ubiquitous in Australian environments. One conspicuous group of arboreal taxa, the *C. macrocephalus* species-group, exhibits morphological adaptations to living in twigs and tree-trunks, but most taxa are terrestrial. Nests of some of the latter species can be recognized by the presence of large mounds, while those of others are represented by inconspicuous holes in the ground. Many Western Australian *Camponotus* live under rocks or logs. If these are lifted from the nest, elongate galleries, full of ants frantically removing their brood, are revealed. Many *Camponotus* are general scavengers and foragers; they also collect nectar and other plant secretions and tend Hemiptera. Some *Camponotus* are associated mutualistically with butterflies, particularly those in the family Lycaenidae (McArthur and Adams 1996; Field 1997). Within the SWBP, nocturnal species can often be recognised by their pale bodies and large eyes. However, members of the crepuscular and nocturnal *C. lownei* complex are among those that retain a dark coloration. While the eastern states *Camponotus consobrinus* (Erichson) is sometimes a minor domestic pest, most of the species in the SWBP do not come under notice by the general public. *Camponotus claripes nudimalis* Forel will occasionally enter houses at night, searching for food scraps or carrion (i.e. dead Indian crickets, etc.).

The SWBP *Camponotus* fauna is extraordinarily rich. At the present time 74 morphospecies can be recognized – more than twice the number for any other formicine genus – though perhaps not all of these represent good species. In the SWBP, *Camponotus* are most strongly represented by the *C. claripes* and *C. nigriceps* species-groups in wetter areas, and by the *C. ephippium* complex and the *C. wiederkehri* species-group in drier areas. The composition of most *Camponotus* species-groups is a work in progress at the present moment. However, two of the groups mentioned above have been recently revised and are strongly supported by morphological characters, these being the *C. nigriceps* (McArthur and Adams 1996), and *C. wiederkehri* (Shattuck and McArthur 2002) species-groups. The *C. macrocephalus* species-group has also been revised (McArthur and Shattuck 2001), and is even more highly distinctive morphologically. Currently, McArthur and his associates are engaged in the revision of the entire Australian *Camponotus* fauna. Two papers have thus far been produced (McArthur 2003, 2007). Information provided here on *Camponotus* distributions outside of WA is largely based on specimens housed in the South Australia Museum and Curtin ant Collection as well as the already published data listed above.

The largely tropical *C. macrocephalus* group has just two representatives in the SWBP. *Camponotus gasseri* (Forel) is typical of those members of this group formerly placed in the subgenus *Colobopsis*. The head of the major worker is truncate and heavily sclerotized and used as a type of living bung to the nest entrance, which is usually found in a tree-trunk or tree limb. Fellow workers antennate the head of the major in order to gain entrance to the nest. *Camponotus gasseri* occurs in all Australian states except the NT. *Camponotus macrocephalus* group sp. JDM 927 is an undescribed species known only from a short series of minor workers collected at Yanchep National Park, north of Perth, in 1989, and, more recently, from a few workers collected in a pitfall trap near Eneabba.

Workers of the *C. nigriceps* species-group are all very large ants, and include some of the largest formicines in the SWBP. Members of the group are easily recognized by the projecting clypeus, which has either a deep median notch in the anterior border or is concave. The projecting edges of the clypeus are always acute. Despite the distinctive appearance of members of the group, however, individual species are morphologically very similar and difficult to identify. Of the nine recognized species, five occur in the SWBP. All can only be identified accurately by examination of the distribution of erect and sub-erect setae on certain parts of the body. *Camponotus longideclivis* McArthur and Adams is the only one of the four taxa that lacks setae on the venter of the head capsule. The distribution of this ant embraces the south-eastern portion of the SWBP, in and around the Esperance region.

Camponotus nigriceps (F. Smith) and *Camponotus dryandrae* McArthur and Adams are two very large and widespread species. Both are very common in the Darling Range, where they are sympatric. The distribution of erect and sub-erect setae on the propodeum distinguishes each species; these setae being continuous along the propodeal dorsum in *C. nigriceps*, and concentrated near the propodeal

angle in *C. dryandrae*. The nests of these ants in the Darling Range are often found in compacted laterite clay around the boles of trees, but are also made directly into soil. The range of *C. nigriceps* probably includes all Australian states, although McArthur and Adams (1996) did not record it for the NT, while *C. dryandrae* is found in the south-west and goldfields in this State. *Camponotus prostans* Forel and *C. dryandrae* are very difficult to separate on morphological characters alone. The only reliable feature is the reduced number of setae found on the venter of the head capsule in *C. prostans*, a feature that requires examination through a microscope. However, in the field their rich reddish- or yellowish-brown-and-black colouration separates most workers of *C. dryandrae* from the more sober, uniformly blackish or brown-and-black *C. prostans*. The latter is mainly confined to the south-west and southern portions of the SWBP, but has been recorded as far afield as the Gibson Nature Reserve, well to the NE of the SWBP. *Camponotus clarior* Forel is a principally eastern, eremaean species that is known in the SWBP from a single collection taken by McArthur from just south of the Billabong Roadhouse, near Shark Bay. The ants were collected from a nest in a hollow branch overhanging a conical mound of excavated soil directly under the nest (A. McArthur, pers. comm.). This species strongly resembles *C. nigriceps*, but workers have a pale coloured head, concolorous with the mesosoma and node. Elsewhere in WA, workers of this species have been collected from the Queen Victoria Spring Nature Reserve, north-east of Kalgoorlie.

The head of the minor worker of *Camponotus perjurus* Shattuck and McArthur has a unique vertex, and this ant cannot be mistaken for any other *Camponotus* species. Shattuck and McArthur (2002) placed this species in its own species-group. The range of this ostensible meat ant mimic is extensive throughout SA and WA, but collections have been very rare. Single foragers have been collected in association with the meat ant *Iridomyrmex spodipilus* Shattuck and also a *Camponotus* species (*Camponotus prosseri* Shattuck and McArthur) (Shattuck and McArthur 2002). Despite its aberrant head capsule, *C. perjurus* seems to me to be otherwise a representative member of the *C. ephippium* species complex, which is widespread and diverse in arid and semi-arid parts of this State. The dentition and character of the mandible, the shape of the mesosoma and petiolar node, and the pilosity pattern all suggest to me that it should be placed in this complex, probably somewhere near *Camponotus ephippium* (F. Smith). The finding of the major subcaste should settle this question, as *C. ephippium* complex major workers are distinctive.

Members of the *Camponotus wiederkehri* species-group have curved setae on the base of the mentum. Many, if not all members of this species-group also possess a rather elongate spiracle. These features are shared with *Melophorus* species, but members of the *C. wiederkehri* species-group can be distinguished from *Melophorus* by the placement of the antennal insertions well above the posterior margin of the clypeus, and by the absence of a metapleural gland.

Ten described species and two or three undescribed members of the group can be found in the SWBP, and this number may increase with further collecting, as several additional species have known distributions that include localities just outside of the SWBP. *Camponotus terebrans* (Lowne) is the most common of these species in the wetter parts of the SWBP, and has a wide range throughout southern Australia. Workers of this species and *Camponotus gouldianus* Forel can be distinguished from the rest of the group by their hirsute antennal scapes and tibiae. Workers of *C. terebrans* are unusually aggressive for *Camponotus* and will readily swarm over and nip anyone who disturbs their nests. This species occasionally enters buildings in outer suburbs of the Perth metropolitan area, and is also known to have a mutualistic association with *Ogyris* spp. (Lycaenidae) (Braby 2000). *Camponotus wiederkehri* group sp. JDM 924 and *Camponotus wiederkehri* group sp. JDM 925 are known in the SWBP only from rehabilitated mineral sand mines in the Eneabba district (*Camponotus wiederkehri* group sp. JDM 924 has also been collected from the Kennedy Ra., inland from Carnarvon). These two colourful red species – or, possibly, a single variable species – are common diurnal foragers on the mine sites. They may be expected to occur on other areas of the Kwongan sand-plain, north of Perth. They can be distinguished from each other by the presence or absence of erect setae on the lower side of the head capsule (seen when the worker is in full-face view).

Workers of the closely related *Camponotus ceriseipes* Clark, *Camponotus prosseri* Shattuck and McArthur and *Camponotus ceriseipes* complex sp. JDM 105 are rather difficult to differentiate (see species-level key for a few useful characters). Some of the worker variation includes attractive orange-and-black or red-and-black ants with shiny gold to off-white pubescence on the gaster. *Camponotus ceriseipes* and *C. prosseri* form a closely related unit. *Camponotus ceriseipes* has been recorded from widely separated localities in the NT, SA and WA, but is confined to the south coast in the SWBP, while *C. prosseri*, separable from the former only by the length of the antennal scape in larger minor workers (and, I think, its colour), occurs in NSW, SA and the southern sector of WA. *Camponotus ceriseipes* complex sp. JDM 105 is thus far only known from Kingsley, a northern Perth suburb, and Chingarrup,

Nornalup and Torbay on the south coast.

Camponotus wiederkehri Forel is a very common large-eyed *Camponotus* of central and northern Australia, but is also found in drier, inland areas of the SWBP. Colour and pilosity vary considerably in this ant. A superficially similar species, but one with a smaller eye and different mesosoma profile, *C. donnellani* Shattuck and McArthur, is known from a single minor worker collected 50 km east of Hyden in sand-plain heathland. Elsewhere this arid zone species has been recorded from the Pilbara and from scattered locations in NT and SA.

In WA, *Camponotus postcornutus* Clark has a known distribution mainly confined to in and around the SWBP, although it is also found in SA. This striking red-and-black ant is a diurnal forager, and both major and minor workers can be seen scurrying quickly over the ground in mallee country. The black-and-gold *Camponotus versicolor* Clark is found in the drier regions of southern and south-eastern WA. This species can be distinguished from the more common and widespread *Camponotus aurocinctus* (Smith), which probably does not occur in the SWBP, by its darker coloration. *Camponotus gouldianus* is another large, arid area species, whose range just overlaps the far south-east of the SWBP. This species is particularly common in SA (Greenslade 1979; Shattuck and McArthur 2002), though it is probably found in all mainland Australian states.

Camponotus johnclarki Taylor has J-shaped setae on the mentum and an elongate propodeal spiracle, and probably should be placed in this group. The minor worker has an odd appearance, its posteriorly attenuated head capsule suggesting an affinity with members of the *C. subnitidus* species-complex. The *C. johnclarki* major worker, however, is quite unlike major workers of the latter group. *Camponotus johnclarki* was originally placed in the genus *Notostigma*, but that is a rainforest genus, whose Australian representatives are confined to tropical and temperate rainforests on the east coast. Taylor (1992), who removed *C. johnclarki* from *Notostigma*, provides distribution details for this species, which also occurs in SA. Workers are rarely encountered, but on several instances I have seen them foraging on *Banksia* trunks in woodland north of Perth.

The remaining *Camponotus* species are not as readily assigned to natural groupings. These taxa may represent radiations related to the well-known *Camponotus claripes* Mayr. The *C. ephippium* species-complex is the most easily defined of these radiations, and major workers in this group can readily be distinguished by their head shape, which has evolved for a similar purpose to that of majors in the *C. gasseri* group. Ants in the *C. ephippium* complex, however, are soil nesters rather than wood nesters, so the head shape in the major workers has not reached quite the same extremes found in majors of the *C. gasseri* species-group. The minor workers in the *C. ephippium* complex are less distinctive than the major workers, but can generally be distinguished from other groupings by a combination of mandibular, head and mesosoma characters (see key). The body of the minor worker is often densely hairy or has thick pubescence.

The *C. ephippium* complex has at least ten representatives in the SWBP, most of these occurring in the drier Wandoo woodland and mallee areas, rather than in the wetter *Banksia* or Jarrah-Marri woodlands or the karri forests of the south coast. Major workers cannot yet be associated with all of the following *ephippium* complex taxa, and I have separated those of which I am aware mainly on the basis of subtle differences in the sculpture of the head capsule. Added to this is the fact that majors are rarely found foraging. Consequently, discussion of the morphology of this group focuses on the minor workers. Several taxa can be grouped phenetically on the basis of the pilosity of their hind tibiae.

Camponotus sponsorum Forel and *Camponotus longifacies* McArthur are two very small *Camponotus*, and in the field minor workers resemble small *Iridomyrmex* species such as *I. chasei* and *I. bicknelli*. In the SWBP these *Camponotus* are typically found in the eastern Darling Range and wheatbelt regions, but occur widely throughout Western Australia, penetrating at least the Pilbara region. *Camponotus sponsorum* is also found in the NT, while the minute *C. longifacies* was described recently from Narrandera, NSW, and occurs in all mainland states. Of the larger ants in which minor workers have a rounded vertex, *Camponotus pawseyi* McArthur, a wheatbelt ant with hairy tibiae and antennae, is easily split from *Camponotus ephippium* complex sp. JDM 775 McArthur, in which these parts lack erect setae. *Camponotus cinereus* Mayr was described from Qld, and may occur in the far north of the SWBP. However, I have not seen reliably identified material belonging to this species, and, based on the appearance of the major worker in images, have some doubts as to whether it belongs to the *C. ephippium* complex. A morphospecies that may prove actually prove to be *C. cinereus*, *Camponotus* sp. JDM 1108, is discussed below.

The other members of the *C. ephippium* complex include minor workers with a rather flattened vertex, one species having a distinct angle between the vertex and sides of the head capsule. In full-face view, the eyes are situated at or near the vertex. These ants are typical members of the *Camponotus* fauna in arid and semi-arid areas of Western Australia. The minor workers of three taxa can be distinguished by lacking erect or semi-erect setae on the hind tibiae. Minor workers

of *Camponotus capito ebenithorax* Forel ('black soma' – McArthur, pers. comm.) are nearly always black with a distinctive red head – though one minor worker from Fitzgerald River NP also has a reddish-orange mesosoma, and ants from near Westonia are all black and lack pubescence on the gaster. Minor workers of *C. capito ebenithorax* have thick pubescence on the gaster, and, while colour variable, are never black with a red head. The two taxa probably represent different species. Both can be separated from *Camponotus dromas* Santschi through inspection of pilosity patterns of the smaller appressed setulae on the head and mesosoma surfaces. While these are mainly separated from one another in the former two taxa, they are linked together in irregular rows in the latter.

The remaining three species in the *ephippium* species-complex have rather shaggier hind tibiae, with semi-erect setae as well as shorter appressed setae. *Camponotus* near *ephippium* (F. Smith) sp. JDM 431 is very similar to the other two taxa, but minor workers have a distinct angle between the eye and the posterior margin of the head capsule that is lacking in either of the latter. Minor workers are very hairy, and usually possess a black-and-red mesosoma. *Camponotus* near *ephippium* (F. Smith) sp. JDM 431 has a known distribution in the states of SA and WA. *Camponotus cinereus notterae* Forel, despite its name, is probably not close to *C. cinereus* and is certainly not closely related to *Camponotus cinereus amperei* Forel. This ant, in which minors are typically hairy and black with orange legs, appears to have its main distribution in the Darling Range near Perth, and in adjacent areas in the south-west wheatbelt, but can be found at least as far east as the Kalgoorlie region. The species may be conspecific with the much more wide-spread *Camponotus ephippium* (Smith), which has a distribution throughout Australian mainland states, but what appear to be small but consistent differences in the minor workers of the two taxa (major workers are less well characterised) are provided in the key.

Camponotus whitei Wheeler and *Camponotus molossus* Forel appear to have affinities with the *Camponotus intrepidus* species-group (or complex), most of whose members are found on Australia's east coast. *Camponotus whitei* has distinctive major and minor workers, with a deeply impressed metanotal groove. In the major worker the mesonotum abruptly descends to the propodeum, a feature not found in any other *Camponotus* major worker in the SWBP. Both sub-castes have a densely punctate sculpture, with stiff, erect, yellow setae. *Camponotus whitei* probably occurs in all the mainland states, though it is most common in the Bassian region. Major and minor workers of *C. molossus* are covered with thick, bristly, erect, setae that are white in this case. *Camponotus molossus* is a very large, black species that appears to have a localized distribution on the Swan Coastal Plain and western Darling Range. The head capsule of the major worker is probably broader than that of any other *Camponotus* species found in the SWBP.

The members of the *Camponotus subnitidus* complex superficially resemble very large *Camponotus claripes* complex workers, but they do possess important differences in the major and minor castes, and probably form a separate taxonomic unit to ants related to *Camponotus claripes* Mayr. Major workers can be fairly easily recognized by their huge, well-armed mandibles (seven or more teeth present), the peculiar, almost circular outer surface of the mandible, and the usually flat vertex of the head capsule. Minor workers may be confused with some minor workers of the *C. claripes* complex with posteriorly attenuated head capsules. However, in the case of *C. subnitidus* complex minors, the edges of the foramen are fluted or flanged, a condition not found in workers of the *C. claripes* complex. *Camponotus johnclarki* also has a flask-shaped border around the foramen, but this species has the J-shaped setae on the mentum characteristic of the *C. wiederkehri* species-group. Two species indubitably in the *C. subnitidus* complex (*Camponotus rufus* Crawley and *Camponotus tricoloratus* Clark) are found in the SWBP. Major and minor workers of *C. tricoloratus* have many setae under the head capsule, but these are lacking or restricted to a single pair in *C. rufus*. Both ants have distinct habitat preferences in western Australia, but also occur in other states. In WA, *C. rufus* is restricted to the more mesic south- and mid-west, while *C. tricoloratus* is also found in the semi-arid and arid areas of this State.

The remaining 40 *Camponotus* taxa here recognized as occurring in the SWBP (along with several I am treating as likely synonyms) are much more homogeneous in appearance. The appearance of the mesosoma, especially in major workers, however, suggests two separate evolutionary radiations, one of which embraces taxa with a long mesosoma and a low propodeum, and the other those with a short mesosoma and a high, sometimes concave propodeum. Major and minor workers of all species, with just one exception, have five or six mandibular teeth.

Of those species in which major workers have long mesosomas, *Camponotus chalceus* Crawley, *Camponotus hartogi* Forel, *Camponotus innexus* Forel and *Camponotus nigroaeneus* complex sp. JDM 1031 are probably very closely related, all being finely sculptured black or red-and-black ants with rather square heads and a concave propodeum. The gaster is matt and minutely punctate-reticulate, and the posterior margin of the tergites is light in colour,

giving these ants a gold-banded appearance in the field. *Camponotus chalceus* is quite common in southern SA and WA, and its WA range includes the more wooded Perth suburbs. This ant nests in trees, including *Banksia*. *Camponotus hartogi* also has a southern distribution, being found in SA, Vic and WA. In the SWBP this species appears to be confined to the south coast. *Camponotus innexus* Forel, otherwise known from the east coast of Australia, is represented in the Curtin Ant Collection by two minor workers from Nerren Nerren Station, on the northern outskirts of the SWBP. This species is currently separated from *C. hartogi* by the appearance of the head capsule in full-face view. *Camponotus nigroaeneus* complex sp. JDM 1031 is known only from two minor workers taken in an intercept trap off a Jarrah (*Eucalyptus marginata* Donn ex Sm.) trunk at Dryandra State Forest, in the southern wheatbelt.

Rather similar to the above four species but lacking the minutely punctate gaster are three other taxa in which the major also has a long, low mesosoma. Minor workers of the reddish *Camponotus scotti* McArthur superficially appear to have more affinity with those of the *C. ephippium* species-complex, but the major worker lacks the posterior lobes to the vertex found in the latter group, and minor workers have six mandibular teeth. Minor workers also have glistening white setae that may be appressed or curled over. This species is not uncommon in the Darling Range, but was described from Jupiter Creek near Adelaide. *Camponotus cinereus amperei* Forel, despite its name, is not closely related to *C. cinereus notterae* but may be close to *C. cinereus*. This species is a common sight in arid and semi-arid woodlands in southern Australia, where workers scurry swiftly across the ground with their gasters vertically raised. The colour of the workers ranges from black (most commonly) to a rich red. This ant was described from Victoria.

Camponotus pitjantjatarae McArthur is very similar to C. *cinereus amperei*, but supposedly differs in the broader, more tapering head and shinier mesosoma of the minor workers (A. McArthur, pers comm.). However, the West Australian material I have available appears to overlap the published boundaries between the two taxa, and I am uncertain as to whether the two are to be thus separated. On the other hand, there appear to be differences in the appressed pronotal setae in minor workers of the two taxa: in *C. pitjantjatarae* these setae are short and well separated, whereas in *C. cinereus amperei* the setae are close together and form a fine pilose covering to the pronotal sclerite.

Camponotus sp. JDM 26 is an ant of uncertain affinities. Both major and minor workers have an odd, transverse notch midway along the propodeum. The immediate impression on seeing a specimen, if one is unfamiliar with the species, is that the animal was damaged during the pupal stage or has a deformity. This species is occasionally collected in the Swan Coastal Plain and Darling Range and has also been collected in the western goldfields, the Esperance sandplains and east of the SWBP. The minor worker has a similar appearance to *C. scotti* and possesses the same glistening white appressed setae, but the major workers of the two species are very different. A possible placement in the *C. ephippium* complex is suggested by the appearance of the head capsule in the major worker and the appearance and dentition of the mandible in both worker subcastes.

The minor workers of *Camponotus claripes minimus* Crawley, *Camponotus darlingtoni* Wheeler and *Camponotus scratius* Forel all have the principal, paired, erect, pronotal setae placed near the mesonotal suture, a synapomorphy not shared with any other *Camponotus* in the SWBP. This closely allies the three taxa, despite the fact that the *C. darlingtoni* major worker has a relatively long, low mesosoma while the major worker of the other two species has a shorter, high mesosoma. (A few *C. darlingtoni* individuals may have additional shorter setae placed in a line with the stout pair, and one specimen from Eneabba also has a tiny erect seta in the centre of the pronotum.) Somewhat incomprehensibly, the name of *C. darlingtoni* was sunk under *C. terebrans*, a species to which it is only distantly related, by Brown (1956), before it was revived from synonymy by McArthur *et al*. (1997). This is an ant of the south-west corner of WA, where it can be found in woodland around Perth and on Rottnest Island.

Camponotus scratius Forel and *Camponotus claripes minimus* Crawley are very small forms, minor workers of *C. scratius* being among the smallest *Camponotus* in Australia. They are both common, and, being very similar in appearance, are easily confused. Both major and minor workers, however, can be distinguished by the presence (*C. scratius*) or absence (*C. claripes minimus*) of setae on the venter of the head capsule. The two species appear to have a wide range in coastal WA, but whereas, in the lower south-west, *C. claripes minimus* is found in both coastal and inland regions, *C. scratius* is rarely found more than a few kilometres from the coast. However, the latter can also be found in inland sand-plain country, east of Kalgoorlie. Minor workers of *C. claripes minimus* vary considerably in appearance from tiny, yellowish forms from the Kwongan sand-plain north of Perth, to rather more robust brown ants in southern districts. Some workers from the goldfields have an orange mesosoma, contrasting with a dark head, petiolar node and gaster. *Camponotus scratius* minors, on

the contrary, vary little in appearance. Forel (1907) described *Camponotus scratius nuntius* from material from Dirk Hartog Island, in the extreme north of the SWBP, but the holotype is lost, probably destroyed, and I am unable to positively identify material answering to the brief description of this ant.

Camponotus with a high propodeum include many SWBP species. In the *Camponotus arcuatus* complex, the mesonotum and propodeum of the minor worker are broad and not laterally compressed in dorsal view. The *Camponotus arcuatus* complex is probably not closely related to the other taxa mentioned below. Only the minor worker is known for *Camponotus arcuatus* complex sp. JDM 694. The appearance of this ant agrees closely with that described for *Camponotus arcuatus aesopus* Forel, but unfortunately the holotype of *C. arcuatus aesopus* has probably been destroyed. This is a shiny black ant of the goldfields, although a closely related species from the north-east coast of Queensland, *Camponotus esau* Forel, is matt in appearance.

The *Camponotus lownei* complex includes *Camponotus* species that characteristically have a dark coloured head and mesosoma, though some have a reddish body. The minor workers are small and compact and have five mandibular teeth. These ants are ubiquitous and common in almost all non-urban environments. Six species are recognized here, each distinguished by consistent differences in head shape, pilosity patterns and colour. In the field the workers are timid, and, if disturbed, readily seek refuge in litter. Based on my collecting experience, most species are probably nocturnal or crepuscular. *Camponotus lownei* Forel, itself, occurs in at least NSW, SA and WA. *Camponotus evae zeuxis* Forel can only properly be distinguished from *C. lownei* by inspection of the major worker (*C. evae zeuxis* having a parallel-sided head, and *C. lownei* a head whose sides converge anteriad). The minor worker of this widespread ant usually has darker appendages than that of *C. lownei*, which characteristically has rich, reddish-brown appendages. The attractive red-and-black *Camponotus armstrongi* McAreavey also belongs to the complex, and the major worker has the same head shape as *C. lownei*. This species mainly occurs outside of the SWBP, but material seen by the author in the California Academy of Sciences was collected near Merredin.

Camponotus simpsoni McArthur is one of several *Camponotus* recently described by McArthur (2003) from South Australian material. *Camponotus lownei* complex sp. JDM 616 is known from the far eastern wheatbelt. The remaining species, *Camponotus lownei* complex sp. JDM 761, is known only from minor workers collected in the Darling Range.

Similar to the *C. lownei* complex in appearance, is what is here called the *C. michaelseni* complex. Like most members of the *C. lownei* complex, those in the *C. michaelseni* complex have a black mesosoma and a high propodeum whose declivitous face is steep and often concave. The members of the latter complex, however, have a minutely punctate propodeum and lower mesopleuron, as compared with a superficially microreticulate or striolate propodeum and mesopleuron in the former. The other major difference is that in the minor worker the sides of the propodeum have a pinched-in appearance, and the declivitous propodeal face viewed from the rear is virtually an edge that may be sharp or blunt, depending on the species. The same body parts in members of the *C. lownei* complex are much less compressed, and the declivitous propodeal face does not have the appearance of an edge in most specimens. Members of the *C. lownei* complex also have a maximum of five mandibular teeth, whereas the number is six in the *C. michaelseni* complex (with the exception of some workers of *Camponotus tristis* Clark, which have five).

The all-black *C. tristis* Clark is widespread in the SWBP, and in semi-arid areas is commonly found foraging on vegetation. The ant is normally matt in appearance. However, a smoother, shinier version has been collected in the Merredin and Westonia districts and more specimens of the latter are needed to find out if the variation in sculpture is continuous. Western Australian material referrable to *Camponotus oetkeri* Forel, *Camponotus michaelseni* Forel and *Camponotus walkeri* Forel, is very similar in appearance, all ants being black with yellow legs or orange legs with dark joints (rarely the entire femora may be black in *C. michaelseni*). *Camponotus oetkeri*, found throughout WA and in the NT, differs from the other two taxa in lacking erect setae on the mesosoma in both worker subcastes. *Camponotus michaelseni*, which may well be synonymous with *Camponotus tumidus* Crawley and *Camponotus walkeri bardus* Forel, judging from descriptions and photographs of the type material, is mostly confined to the south-west. Within this area it is most common in the laterite soil of the Darling Range where its nests under stones are readily found. *Camponotus walkeri* was described from a major worker from East Wallabi Island in the Abrolhos, and the colour is given as 'brownish-black' (Forel 1893). Specimens from NSW believed to be *C. walkeri* are held in SAMA, and these have lighter brown bodies. All specimens I have seen from WA, however, are black with light yellow legs. This species is not uncommon in some Perth coastal parklands where native vegetation persists, and has also been collected as far east as Coolgardie, and as far north as Shark Bay. The taxon here identified as *Camponotus oetkeri voltai* Forel differs slightly in colour from the syntype material from Tasmania, but I believe the two are conspecific. The species is recognised among similar ants by its shagreenate

appearance (minor worker) and plentiful erect setae on the mesosoma and under the head capsule (both major and minor sub-castes). In the SWBP *C. oetkeri voltai* is confined to wetter and better-vegetated areas of the south-west. The recently described *Camponotus rudis* McArthur appears to be a synonym of this species.

Three very small orange *Camponotus* with a high propodeum complete the group with a high, concave propodeum. These do not appear to be closely related to the other taxa, but share with the *C. lownei* group a similar mandible with a compliment of five teeth. *Camponotus* sp. JDM 695, known from minor workers only, has a deeply concave propodeum and densely foveate sculpture. *Camponotus* sp. JDM 771 has a less concave propodeum and foveate-punctate sculpture. In WA, both species are known from a handful of specimens collected in the eastern wheatbelt and adjacent goldfields. Also from the goldfields is *Camponotus* sp. JDM 1038, which is quite similar to the other two species, but has fine, parallel striolae on the mesopleuron and propodeum. The major worker is a bright, glossy orange with a bulbous head and five mandibular teeth.

Major workers here referred to the *C. claripes* complex are easily recognized by the presence of short erect and sub-erect setae on the genae and sides of the head capsule and the punctate, rugose or otherwise sculptured cuticle on and around the clypeus, but minor workers are much more nondescript when compared with related species. Members of this complex are very common in all ecosystems in the SWBP, and, if disturbed, minor workers have the interesting defence mechanism of drawing their limbs close to their bodies and feigning death (thanatosis). This ruse is particularly effective if they are on tree-trunks, when they will free-fall to the ground if touched. Lying immobile among vegetation, twigs and leaf litter, these small-medium ants are then almost impossible to find.

Camponotus claripes Mayr needs much research in order to delimit the taxon successfully: what is here defined as '*C. claripes*' is almost certainly a species cluster. The major workers in the *C. claripes* group are often represented as having a bilobate anterior clypeal margin (e.g. Greenslade 1979). This is also true for *C. claripes* Mayr minor workers. However, minor workers in the SWBP that appear to belong to *C. claripes* invariably lack this feature, the anteromedial clypeal margin being straight in most populations, and faintly convex in the remainder. *Camponotus claripes* was described from material collected in NE Queensland, but three subspecies were described from material collected in the SWBP. These are, in fact, distinct and recognizable species. *Camponotus claripes minimus*, which does not actually belong to the *C. claripes* complex, has already been mentioned, and *Camponotus claripes nudimalis* Forel is discussed below: major workers do not have a hirsute head capsule in this species. *Camponotus claripes marcens* Forel, however, is a member of the *C. claripes* complex with unique behaviour for the group. The brightly-coloured minor workers with a yellow-and-black gaster are most commonly encountered, often as they are running rapidly up and down Jarrah and Marri trunks. These ants will seek to evade detection by keeping to the opposite side of the tree to the side where the observer is standing. *Camponotus claripes marcens* has a more limited range than many of its close relatives, and seems to be confined to the Darling Range and southern wheatbelt. The form of *C. claripes sensu stricto* most commonly seen in the south-west agrees very closely with an eastern states subspecies, *Camponotus claripes inverellensis* Forel and has the same bicoloured head, but the major workers of the local ant have a reddish brown rather than a pale yellow mesosoma. Another light-coloured, eastern states form, *Camponotus claripes piperatus* Wheeler, which is very similar to the above sub-species, may also be present in the south-west of WA. In the wetter jarrah forests is another form with a dark head that is not pale coloured anteriorly (unlike the head of the two forms mentioned above) and heavily infuscated legs.

Three probably undescribed members of the *C. claripes* complex that appear to represent good species are here designated as *Camponotus claripes* complex sp. JDM 430, *Camponotus claripes* complex sp. JDM 767 and *Camponotus claripes* complex sp. JDM 779, respectively. *Camponotus claripes* complex sp. JDM 767 is the largest member of the group, and minor workers are rather hairy, with many long setae on the head, body and venter of the head capsule. This ant has much the same range as *C. claripes marcens*. The minor workers of *Camponotus claripes* complex sp. JDM 430 and *Camponotus claripes* complex sp. JDM 779 are very similar, both being dark brown ants with a shagreenate exoskeleton. The former, though, has a narrow mesosoma reminiscent of the *C. maculatus* complex, none of whose members appear to occur in the SWBP, and the pilosity bears some resemblance to that of *C. scotti*. The major workers are also quite distinct (see key). Both species occupy habitats on the east slopes of the Darling Range and in the adjacent wheatbelt. *Camponotus claripes* group sp. JDM 288 has a distinctive major worker that has a pitted clypeus but lacks erect setae on the side of the head. However, minor workers of this species are very difficult to distinguish from those of both *Camponotus claripes* and *Camponotus claripes nudimalis*. This ant appears to have its stronghold on the drier eastern flanks of the Darling Range, where nests can be found under stones.

Six medium-sized orange or orange-and-brown species have a similar *facies* to the foregoing species, but the major workers have a smooth clypeus and the propodeum in the minor workers is somewhat higher in relation to its dorsal surface. Minor workers also tend to have a high, narrow petiolar node (usually thicker and bluntly rounded in minor workers from the *C. claripes* complex). These ants are among the most common *Camponotus* in the SWBP. *Camponotus gibbinotus* Forel is a nocturnal ant often seen in drier areas. The minor workers are frequently found standing stationary on twigs or grass stems, with only their antennae moving. Major workers have a flat or faintly carinate clypeus with a slightly projecting, rectangular anterior margin. The margin is crenulate. The taxonomic position of the very closely related *Camponotus discors* Forel is at present unclear. The only officially recognized difference between the two nominal taxa is the distribution of the erect setae on the underside of the head capsule (A. McArthur pers. comm.). Molecular methods will be needed to ascertain whether the two taxa represent distinct species or are only morphs of a single species. (In fact, *C. gibbinotus* itself may be a species complex, there being rather large differences between the minor workers, both in terms of size, the number and appearance of the mandibular teeth and the slope of the propodeum). These ants are widely distributed throughout mainland Australia. The major and minor workers of *Camponotus cowlei* Froggatt differ from *C. gibbinotus* and *C. discors* only in that a few to many erect and suberect setae can be found on the lower sides of the head capsule and on the genae.

Minor workers of *Camponotus discors* complex sp. JDM 772 are dark reddish-brown to blackish, gracile ants with light yellow legs. This species shares with some populations of *C. gibbinotus* minor workers a dentition of five mandibular teeth or four teeth and a bifurcated basal tooth. The major worker of *Camponotus discors* complex sp. JDM 772 is not known. This species occurs sparsely on sandplains, mainly in coastal parts of the SWBP, but has also been collected in the Pilbara. A single, dark, minor worker specimen from Eneabba shows some similarities with this taxon, but cannot be placed with confidence at the moment. *Camponotus discors* complex sp. JDM 1104 is a shaggy species, close to *C. cowlei*, known in the SWBP from one collection in the Shark Bay region and a single major worker from Westonia in the western goldfields. A very similar species has been collected in the Pilbara.

Camponotus claripes nudimalis Forel is a dark-headed form apparently confined to the south-west. This is one of the very few *Camponotus* species that will forage inside Perth houses. Major workers can be distinguished from those of *C. cowlei*, *C. discors* and *C. gibbinotus* by their bilobate clypeus. At least some colonies of this ant make their nest in living trees. A well-grown *Eucalyptus ficifolia* F. Muell on the author's property contains a nest of *C. claripes nudimalis*, with tunnels under the outer bark. Copious amounts of sawdust within bark crevices, and on the ground around the tree indicate that these ants have been actively engaged in excavating wood from the living tree, even though the colony may have been established in pre-existing cavities made by another arthropod.

Camponotus discors angustinodus Emery, first described as an infrasubspecific form by Forel in 1907 (Forel 1907), is one of several *Camponotus* species *inquirenda* collected in the SWBP likely to belong to the *C. claripes* group. Forel examined specimens from localities as widely separated as Denham, Day Dawn and Mundaring Weir, so the ant is in all probability a common and widespread species. He also compares the worker appearance with that of *C. gibbinotus*. However, the description of the worker is short, and omits important information about colour, pilosity and appearance of the head capsule. Although non-type material in the MCZ carrying the name '*Camponotus discors angustinodus*' is identical to *C. claripes nudimalis*, the former workers came from Augusta, on the south coast. For the time being therefore, the identity of *C. discors angustinodus* must be regarded as problematic, although *Camponotus claripes nudimalis* remains a strong candidate. Another problematic taxon that belongs in this general vicinity is *Camponotus insipidus* Forel. I have also seen non-type material in MCZ labelled '*Camponotus insipidus*': the workers are very like the pale yellow *C. claripes minimus* found in the Kwongan sand-plain in the Eneabba district, but the major worker has a swollen head that has granular sculpture around the clypeus and lower genae – not unlike *Camponotus claripes* group sp. JDM 288 major workers. What can be said with a fair degree of certainty is that these ants are typical members of the *C. claripes* species-group. *Camponotus insipidus* was described from East Wallabi Island, in the Abrolhos.

The remaining two species in the *C. claripes* species-group have a *facies* similar to that of members of the *C. subnitidus* species complex, with long, low mesosomas and a low, bluntly acuminate petiolar node. However, the major worker (known only for *Camponotus claripes* group sp. JDM 63) does not have the features of the head and mandible found in *C. subnitidus* group majors, and minor workers of both species lack fluted edges around the foramen. Minor workers of *Camponotus claripes* group sp. JDM 63 are unique among their relatives in that their mandibles each have eight to ten teeth. The major worker, however, has the regulation six

teeth. This insect is confined to wetter parts of the south-west, and is occasionally collected in Perth urban bushland. *Camponotus claripes* group sp. JDM 1073 is known from one specimen, a minor worker, collected in a bark trap on Wandoo at Dryandra.

Melophorus

Although this genus is polymorphic, there is generally relatively less difference, apart from the broad head capsule in the major, between the major and other worker castes than there is in genera like *Pheidole* and *Camponotus*. The characteristics of all worker castes of *Melophorus*, therefore, are included in this key. The major workers for some species, however, are unknown.

1. Propodeum in major and minor workers armed with stout denticles, directed vertically; head, mesosoma and nodes strongly shagreenate; matt in appearance; minor worker with elongate head capsule, in full-face view, about three times as long as wide (very rare, sandplain E of Albany and Eneabba region) (Figure 332) ..... ***M. majeri* Agosti**

   Propodeum unarmed in all worker castes; appearance otherwise not as above **2**

2. In profile, head (at least of minor and media workers) extremely flattened (Figure 333); outline of dorsum of mesosoma almost straight (characteristics of major worker unknown)..... ***Melophorus* sp. JDM 787**

   In profile, head not extremely flattened; outline of dorsum of mesosoma usually sinuate, with pronotum and/or propodeum elevated above plane of mesonotum..... **3**

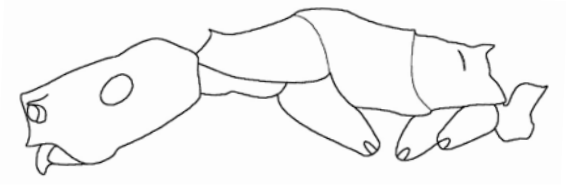

Figure 332

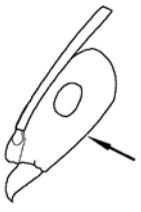

Figure 333

3. In profile, propodeum elongate, often descending obliquely towards its junction with petiole (mainly *M. iridescens* species-group) (e.g. Figure 334)..... **4**

   In profile, propodeum compact, smoothly rounded or truncate with distinct dorsal and declivitous faces (e.g. Figure 335) **6**

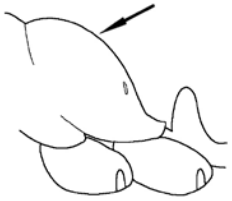

Figure 334

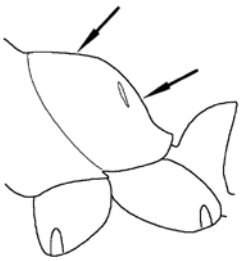

Figure 335

In profile, pronotum very weakly convex; propodeum weakly convex with long dorsal face (gracile, uniformly orange ants; arid to semi-arid environments)..... ..... ***Melophorus* sp. JDM 199**

In profile, pronotum distinctly rounded; propodeum describing oblique arc (Figure 334) **5**

5. Larger (major workers TL ≈ 7–9 mm, media and minor workers TL ≈ 4–6 mm); metanotal groove in all workers usually more deeply impressed, so metathoracic spiracles are more-or-less dorsally situated (Figure 335); minor workers most commonly with red or reddish-brown foreparts (drier areas of SWBP) ..... ***Melophorus* sp. near aeneovirens (JDM 545)**

   Smaller (major workers TL ≈ 5–6 mm, media and minor workers TL ≈ 3–4 mm); metanotal groove in all workers usually more shallowly impressed, so metathoracic spiracles are more-or-less laterally situated (Figure 337); minor workers most commonly with ochre to dark brown foreparts and brown to black gasters, never red, and usually not reddish-brown (widespread, but most abundant in wetter, forested areas of the south-west)..... ..... ***M. insularis* Wheeler**

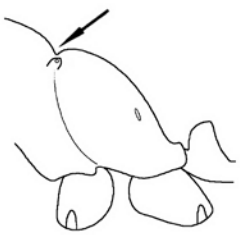

Figure 336

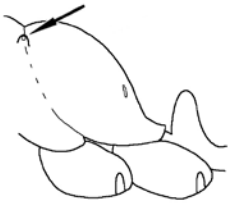

Figure 337

6. Minor worker with many short, peg-like bristles covering the body (Figure 338); cuticle finely microreticulate with a yellowish sheen (major worker unknown) .... ***Melophorus* sp. JDM 613**

   Minor worker without peg-like bristles; appearance of cuticle not as above **7**

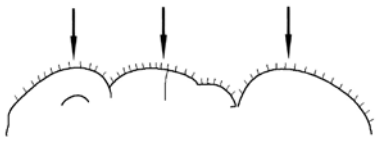

Figure 338

7. Mandible very large (2/3–3/4 length of head capsule), hatchet-shaped (Figure 339) .... ***M. potteri* gp. sp. JDM 1032**

   Mandible of normal proportions, triangular or strap-like in shape (e.g. Figures 340, 341) **8**

Figure 339

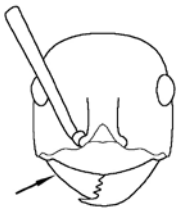

Figure 340

Figure 341

8. Propodeal spiracle very large and conspicuous, about 2/3 x length of declivitous face of propodeum; spiracle placed slightly nearer declivitous face of propodeum than metanotal groove (Figure 342) **9**

   Propodeal spiracle smaller and/or placed much closer to declivitous face of propodeum (often on edge of its surface) (Figures 343, 344) **10**

Figure 342

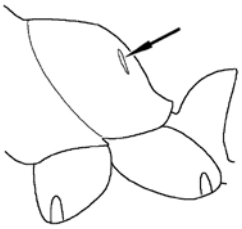

Figure 343

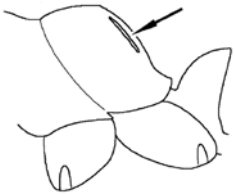

Figure 344

9. In profile, anterior margin of clypeus protruding (Figure 345); in full-face view, frons unsculptured, smooth and glossy..... ..... ***M. potteri* McAreavey**

   In profile, anterior margin of clypeus curved inwards (Figure 346); in full-face view, sculpture of frons finely microreticulate, matt or with a dull sheen..... ..... ***M. potteri* gp. sp. JDM 1082**

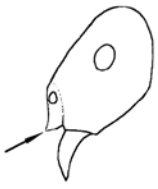

Figure 345

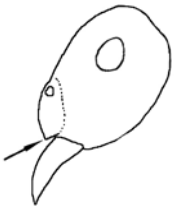

Figure 346

10. Posterior of mesonotum extended as a lobe, overhanging the propodeum; dorsal face of propodeum very narrow, almost wedge-shaped in profile; metathoracic spiracle facing laterad, in one species situated well before junction of mesonotum and propodeum (Figure 347) **11**

    Mesonotum less developed, not overhanging propodeum; dorsal face of propodeum longer; metathoracic spiracle usually facing dorsad (e.g. Figure 348)..... **12**

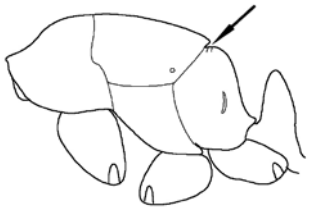

Figure 347

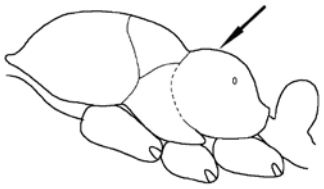

Figure 348

11. Major and minor workers with scattered, short, erect setae on mesosoma; appressed setae longer (length ≈ greatest width of antennal scape) almost adjoining on mesosoma and gaster; metathoracic spiracle situated near junction of mesonotum and propodeum ....***Melophorus* sp. JDM 230**

    Minor worker lacking erect setae on mesosoma; appressed setae shorter (length < greatest width of antennal scape) well separated on mesosoma and gaster; metathoracic spiracle situated well before junction of mesonotum and propodeum ....***Melophorus* sp. JDM 1063**

12. Dorsal surfaces of body with short, modified, spatulate setae (Figure 349); body covered with fine, whitish-yellow pubescence (more distinct in minor workers)..... .....***Melophorus* sp. JDM 784**

    Either modified setae absent, or, if present, then confined to pronotum and body not pubescent as above **13**

13. Body, legs and antenna of minor covered in long, erect and downy, appressed setae; body slender, gracile (*Iridomyrmex*-like); in profile eye very large (eye length >1/3 length of head capsule) (Figure 350); cuticle matt, finely microreticulate; clypeus protruding (major worker unknown) ....***Melophorus* sp. JDM 788**

    Body often smooth and shining with few erect setae; if hairy, then either body not gracile and *Iridomyrmex*–like, or eye smaller or clypeus not protruding..... **14**

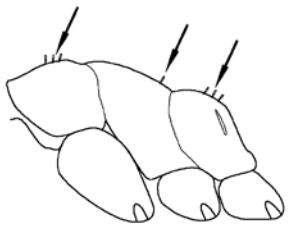

Figure 349

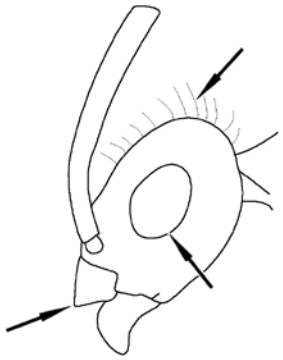

Figure 350

14. Major and minor worker with fine pubescence, silvery in minor worker, mesosoma with many short, erect setae; in profile pronotum and mesonotum of minor worker gently convex to almost straight..... .....***M. mjobergi* Forel**

    If major worker also with fine pubescence (usually lacking), then pronotum and mesonotum of minor worker more convex, often protuberant..... **15**

15. Major and minor workers with abundant fine pubescence on frons of head capsule (relatively large, reddish northern species)..... .....***Melophorus* sp. JDM 1105**

    Major and minor workers without abundant fine pubescence on frons of head capsule..... **16**

16. Mesonotum bulbous, translucent or even transparent, ground colour distinctly paler than surrounding mesosoma (small species, TL of minors ≈ 2 mm)..... .....***Melophorus* sp. JDM 500**

    Mesonotum, if protuberant, not translucent, usually the same colour as rest of mesosoma but may be slightly paler **17**

17. Large size discrepancy between smallest minors (HW ≤ 0.5 mm) and largest major workers (HW ≥ 2mm); pale orange to depigmented yellow ants, with colour of frons often gradually darkening towards vertex; declivitous face of propodeum strongly oblique when seen in profile (e.g. as in Figure 343); minor workers without erect setae on dorsum of mesosoma ..... ***M. ludius sulla* Forel**

Size more uniform among subcastes (see couplet 18 below); if very pale, then without above combination of features (propodeum of small yellow or yellowish workers often with weakly oblique or abruptly vertical declivitous face (e.g. as in Figure 353 below) ... **18**

18. Small species (major worker HW ≤ 1 mm, minor worker HW ≤ 0.5 mm) **19**

Species larger (major worker HW ≥ 2mm, minor worker HW ≥ 0.8 mm) **26**

19. Major and minor workers with erect, usually long setae on mesosoma **20**

Minor workers, at least, glabrous or pubescent, without longer, erect setae on mesosoma **24**

20. In minor worker (major worker unknown) sculpture of head and mesosoma completely microreticulate, appearance of cuticle uniformly matt, dull; pilosity consisting of two or three very short, bristle-like setae, arranged transversely across central sector of pronotum ..... ***Melophorus* sp. JDM 1180**

Sculpture of minor worker not as above, sculpture reduced or absent on pronotum and mesonotum particularly, these parts more-or-less shining in appearance; pilosity more extensive, usually consisting of long, fine erect, curved setae **21**

21. In minor worker, pronotum globose (Figure 351); propodeum truncate or sharply rounded in profile; erect setae on pronotum and mesonotum relatively long (> diameter of eye); eye moderate (eye length 1/5 x length of head capsule); viewed dorsally, pronotum and mesonotum smooth and shiny in appearance in minor worker (Major worker similar in appearance to *Melophorus* sp. JDM 176 – see couplet 22 – but with scattered erect setae on entire mesosoma) ..... ***Melophorus* sp. JDM 470**

In minor worker, pronotum either not noticeably globose (Figure 352); or erect setae on pronotum and mesonotum relatively short (≤ diameter of eye) (single worker of Melophorus sp. JDM 176); eye larger (eye length ≈ 1/3 length of head capsule) in remaining spp..... **22**

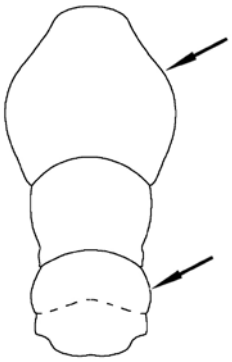

Figure 351

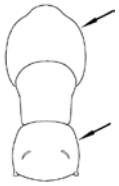

Figure 352

22. Eye moderate, eye length 1/5 x length of head capsule; in profile, propodeum of minor worker truncate (Figure 353), its dorsal face < half length of its declivitous face; erect setae on mesosoma short bristles, their length ≈ greatest width of antennal scapes ..... ***Melophorus* sp. JDM 176 (pt.) (a single minor worker)**

Eye large, eye length ≈ 1/3 length of head capsule; in profile, propodeum of minor worker usually distinctly rounded, though may be narrowly so (Figure 354); erect setae on mesosoma fine, not bristle-like, length usually > greatest width of antennal scapes ... **23**

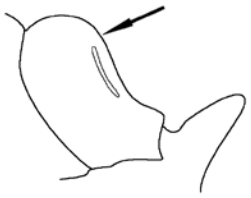

Figure 353

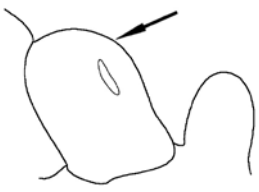

Figure 354

23. Inner edge of antennal scape in major and minor worker with many erect setae arising at angle of 90° (Figure 355); mesosoma clothed in fine, curved erect setae .....
.....***Melophorus* sp. JDM 1070**

Antennal scape lacking erect setae (Figure 356); mesosoma with moderate to sparse erect pilosity .....***Melophorus* sp. JDM 786**

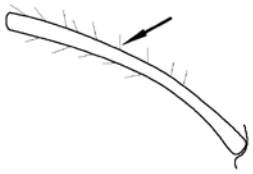

Figure 355

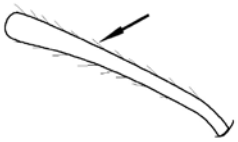

Figure 356

24. In full-face view, head of minor worker narrow, longer than wide with a strongly convex vertex (Figure 357a); in profile, propodeum rising above level of mesonotum, which is straight; hind femur gradually decreasing in diameter to about its midpoint, thereafter femur of same diameter up to its articulation with the tibia (Figure 357b) (possible major worker known but not confirmed) .....
.....***Melophorus* JDM 1102**

In full-face view, head of minor worker more-or-less square, about as long as wide; vertex straight or weakly convex (Figure 358); in profile, propodeum below level of mesonotum which is gently to strongly convex; hind femur gradually decreasing in diameter virtually throughout its entire length (Figure 359) .....
..... **25**

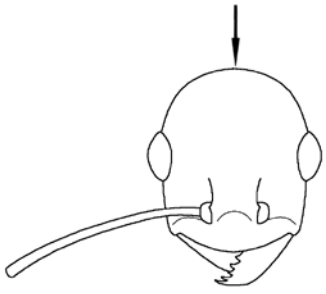

Figure 357a

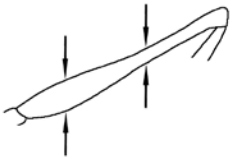

Figure 357b

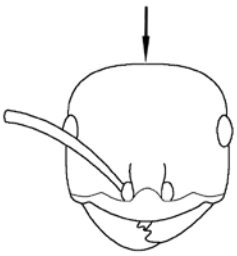

Figure 358

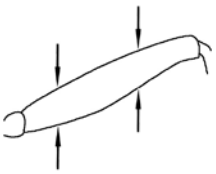

Figure 359

25. Major worker with scattered, longer (i.e. eye width >), thin, erect setae on dorsum of pronotum, mesonotum and propodeum; cuticle of minor worker almost completely smooth and shining; mostly light, depigmented yellow with greyish or black gaster, head may be light orange-red (n.b. widespread, dark minor workers, presently unassociated with majors, may belong to another species) .....
.....***Melophorus* ANIC sp. 3**

Major worker with a few shorter (i.e. eye width <), stout, erect setae on dorsum of pronotum and sometimes mesonotum; cuticle of minor worker finely shagreenate or with superficial microreticulation, colour variable, often concolorous brown or reddish-brown or with foreparts orange, legs brown, gaster black .....
.....***Melophorus* sp. JDM 176 (most workers)**

26. In profile, head capsule of major and media workers massive and broad, eye placed well in front of midline of head capsule (Figure 360a), length of head capsule and mandible in major and media workers approximately length of mesosoma; basal margin of mandible in media workers may have a tusk-like tooth (Figure 360b) (*M. wheeleri* complex).
..... **27**

In profile, head capsule of major and media workers less massive and broad, eye placed slightly in front of midline of head capsule (Figure 361), length of head capsule in major and media workers less than length of mesosoma; basal margin of mandible in media workers without tusk-like tooth..... **29**

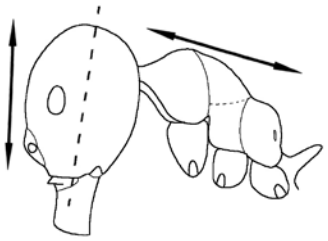

Figure 360a

Figure 360b

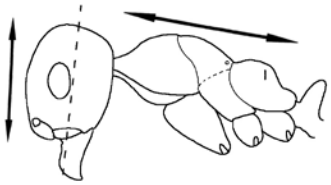

Figure 361

27. Mandible of minor worker with 7 or more denticles; frons of head capsule of major and minor worker dull and finely sculptured .... ***M. wheeleri*** **Forel**

    Mandible of minor worker with 5 or 6 denticles; frons of head capsule of major and minor worker with vestigial or no sculpture, shining in appearance **28**

28. Head orange to chocolate, mesosoma orange to dark reddish brown, gaster black; media worker with tooth in middle of basal margin of mandible (Figure 360b); masticatory margin of mandible in minor worker weakly oblique, basal tooth strongly offset (Figure 362) .... ***M. wheeleri*** **complex sp. JDM 783**

    Mesosoma and gaster shining black, head slightly lighter; media worker without tooth in middle of basal margin of mandible (NE fringe of SWBP); masticatory margin of mandible in minor worker weakly offset (Figure 363) .... ***M. wheeleri*** **complex sp. JDM 1077**

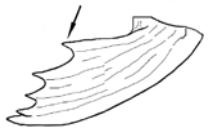

Figure 362

Figure 363

29. In minor worker, mesosoma rarely with a few erect setae, these lacking in most specimens; sculpture of head and mesosoma reduced or absent, appearance shining **30**

    In minor worker, mesosoma with many erect, usually long setae; head and mesosoma usually dull, shagreenate, less often shining... ..... **31**

30. In profile, mesonotum of major and minor worker moderately convex (Figure 364); major worker without setae or with 6 < erect setae, mainly on pronotum; propodeum tending to truncate in outline .... ***M. turneri perthensis*** **Wheeler**

    In profile, mesonotum of major and minor worker straight or nearly so (Figure 365); major worker with 6 > erect setae on pronotum; propodeum generally more rounded in outline..... ***M. turneri*** **Forel (pt.)**

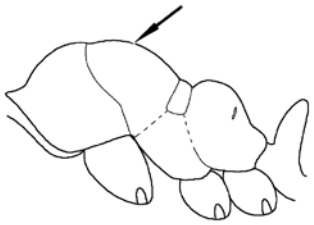

Figure 364

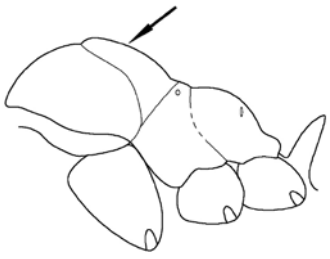

Figure 365

31. Femora with whorls of long, erect, straight setae (Figure 366), head, mesosoma and gaster with very many long, fine, erect setae .... ***M. turneri*** **complex sp. JDM 791**

    Femora lacking whorls of long, erect, straight setae, setae mainly appressed or decumbent (Figure 367); setae on head, mesosoma and gaster shorter, often giving a shaggy appearance to the ant **32**

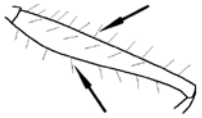

Figure 366

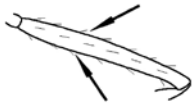

Figure 367

32. In profile, anterior margin of minor worker clypeus projecting, so mandibles close well underneath it (Figure 368) (putative major worker cannot be distinguished from *M. bruneus* McAreavey majors)..... .....***M. mjobergi* complex sp. JDM 1121**

In profile, anterior margin of minor worker clypeus curved inward, so mandibles just below it and on the same plane (Figure 369) **33**

Figure 368

Figure 369

33. Eye large and protuberant (eye length 1/3 head length <) (370a); hind tibia without erect and semi-erect setae (Figure 370b) (major worker unknown)..... .....***M. bruneus* complex sp. JDM 600**

Either eye smaller, less protuberant (eye length ≈ ¼ head capsule) (Figure 371), or hind tibia with semi-erect setae.....**34**

Figure 370a

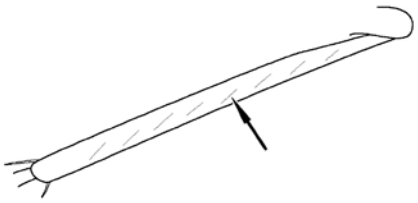

Figure 370b

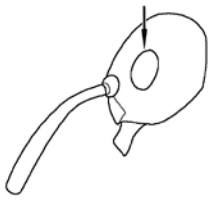

Figure 371

34. Antennal scape finely sculptured, with many erect setae on all surfaces (Figure 372); sculpture in minor and media workers shagreenate; setae on body rather short and erect (≤ greatest antennal width)..... .....***M. bruneus* complex sp. JDM 520**

Antennal scape smooth, setae predominantly appressed, erect setae nearly always more sparse than in *M. bruneus* complex sp. JDM 520, normally present on outer surface only and may be completely absent (Figure 373); sculpture in minor and media workers reduced, so cuticle is usually shining; setae on body longer (except in coastal populations) (longest setae ≥ greater than greatest antennal width, and curved, giving ant a shaggy appearance).....***M. turneri* Forel (pt.)**

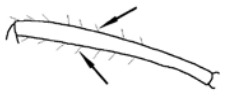

Figure 372

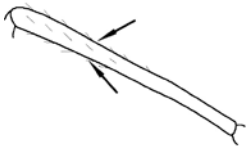

Figure 373

Some 32 species and subspecies of this exclusively Australian genus have been described, but this is only a fraction of its true diversity. Many *Melophorus* species have their main centres of distribution in remote desert regions, and the genus as a whole is not strongly represented in the wetter, coastal areas that have been well-collected by taxonomists and their assistants. Nonetheless, 33 morphospecies of *Melophorus* have been identified in the SWBP to this point of time, though reliable names can be assigned to less than one quarter of these.

Historically, at least some of the desert-dwelling species have been called honeypot ants, but perhaps Andersen's (2002) suggested common name of 'furnace ants' for the genus is preferable, since it avoids confusion with similar 'honeypot' ants in unrelated overseas genera (e.g. *Myrmecocystus*) as well as a few desert-dwelling *Camponotus* species, and accurately describes the thermophilic nature of most *Melophorus*.

The genus *Melophorus* is characterised by a combination of a slit-like propodeal spiracle, the presence of a metapleural gland and antennal insertions that abut the posterior margin of the clypeus. Workers are polymorphic. All known species are terrestrial, nesting directly into soil. For the most part, workers forage on the ground, but in the SWBP at least two species, including one that possesses a peculiarly flattened head, have been collected on tree-trunks. *Melophorus* are summer active and are rarely seen in the cooler seasons of the year. Workers are typically very fast moving and extremely timid. If they are disturbed at their nest hole, even by so much as the shadow of an observer, they may not return above ground for several minutes. From observations, local species appear to include a lot of plant material, particularly seeds of grasses, in their diet.

The bulk of the *Melophorus* fauna in the SWBP appears to belong to what is here termed the *M. turneri* species-group (Wheeler, describing the Rottnest Island ant fauna in 1934, refers to the '*turneri* Formenkreis' in WA). Minor workers of the *M. turneri* group possess a short, rounded or truncate propodeum and a distinctive, striated mandible. The mandibular teeth typically include two stout apical teeth, a smaller third tooth, and two stout, basal teeth, but additional teeth can be present in some taxa. Several smaller complexes are easily identified within this group, which may be related to the northern *M. fieldi* species-group (the latter *sensu* Andersen 2000). The *M. aeneovirens* species-group includes two common and widespread species in which the minor has a long, oblique propodeum. In addition to these major groupings, the residue of species contains several that appear to lack close relatives. Their workers, in some instances, exhibit a bizarre morphology, the reason(s) for the evolution of which one can only guess at.

In terms of abundance, the *M. turneri* species-group dominates in the SWBP, and its representatives can be found in most habitats. The reddish-brown *Melophorus turneri perthensis* Wheeler is familiar to many Perth city dwellers, even those without an entomological interest. This species is the *Melophorus* most commonly seen in and around the city in summer, when it is active on sandy verges, urban dune systems and backyards. The amount of sand displaced by this ant is considerable. Workers can often be seen taking grass seeds, other plant material and occasionally small carrion back to their nests. Under a microscope, workers of this species can be identified by their bulbous mesonotum. In the very similar *Melophorus turneri* Forel, on the other hand, the mesonotum does not protrude. The latter is the *Melophorus* most commonly seen in country areas, where it is ubiquitous in almost all habitats away from the wettest areas. Even paddocks that carry only a very depauperate ant fauna will usually support colonies of this species. Both ants have a broad distribution in WA, though they have most often been collected in the south-west of the State. *Melophorus turneri*, at least, also occurs in QLD and probably other mainland states. *Melophorus turneri*, as here defined, is a very variable species in terms of pilosity and appearance of the cuticle: commonly the more hirsute workers have a matt, shagreenate cuticle while those that are more-or-less glabrous are smooth and shiny. However, this is not invariably the case. Colour of the cuticle ranges from pale yellowish-brown or red to almost black. Most workers, whatever their colour, tend to have a coppery iridescence. Dark brown to black populations close to the coast have smaller eyes, especially among the minor and media workers. These populations may be worth closer investigation when the group is revised. In the meantime, they are being treated as part of the natural variation within the species.

Melophorus ludius sulla Forel is a pale version of *M. turneri*. This species occurs in drier areas of the State, away from the wetter south-west corner and south coast. *Melophorus ludius sulla* was described from the NT, but may also be expected to occur in inland NSW and SA and possibly other parts of the mainland. The northern *Melophorus turneri* complex sp. JDM 791 is more hirsute than even quite hairy *M. turneri*, with long, straight, erect setae on the antennae and tibiae.

The *Melophorus wheeleri* complex has at least three representatives in the SWBP. Major workers have massive heads in which are housed the muscles needed to move their powerful, grinding mandibles. These are specialist seed harvesters (Andersen 2000), and are generally confined to arid and semi-arid regions. *Melophorus wheeleri* complex sp. JDM 783, however, can be found as far south as Perth. Media and major workers of this species are unmistakeable because of the tusk-like tooth in the middle of the basal margin of the mandible. However, minor workers belonging to the complex, including those of *Melophorus wheeleri* complex sp. JDM 783, as a group are difficult to differentiate from those of *M. turneri* and its close relatives. *Melophorus wheeleri* complex sp. JDM 783 is quite