Ants (Hymenoptera: Formicidae) of Alberta: A key to species based primarily on the worker caste

James R.N. Glasier[1], John H. Acorn[2], Scott E. Nielsen[2], and Heather Proctor[3]

[1] Corresponding author: Department of Renewable Resources, University of Alberta, Edmonton, AB, T6G 2H1 jglasier@ualberta.ca

[2] Department of Renewable Resources, University of Alberta, Edmonton, AB, T6G 2H1 john.acorn@ales.ualberta.ca, scott.nielsen@ales.ualberta.ca

[3] Department of Biological Sciences, University of Alberta, Edmonton, AB, T6G 2E9 hproctor@ualberta.ca

Abstract

We present an overview of the known ant fauna of Alberta, Canada, which consists of 94 species and subspecies in 16 genera and three subfamilies. Two potentially new species were identified in the genus *Myrmica*, while the rest of the fauna is represented by previously recognized taxa. We provide an illustrated HTML-based dichotomous key to species of ants in Alberta based mostly on morphological characters of the worker class. When keyed to a species, a hyperlink to its species profile on www.antweb.org is provided for photographic and locality comparison.

Introduction

Worldwide, ants (Hymenoptera: Formicidae) are recognized as important ecosystem engineers that affect nutrient cycling, soil structure, seed dispersal, and the populations of many other invertebrates (Briese 1982; Hölldobler and Wilson 1990; Jones et al. 1994; Folgarait 1998). From an anthropocentric point of view, many ants are considered pests because of their abilities to disrupt lawns and infest homes, and their habit of viciously defending their colonies through biting and stinging (Klotz et al. 2008). Although ants are widespread and abundant throughout Alberta, little is known about their ecology or diversity in the province.

The study of Alberta's ant fauna began with Sharplin (1966), who assembled an annotated list of 40 species known to occur in the province. Sharplin built on the faunistic and revisionary works of such American workers as Wheeler (1905, 1913), Creighton (1950), Wilson (1955), and Wheeler and Wheeler (1963). Since then, a number of new species have been described from Alberta (Buschinger 1979, 1983; Heinze 1989; Mackay and Buschinger 2002; Buschinger and Schultz 2008), five genera with representatives in Alberta have been partly or entirely revised or reviewed (Francour 1973 for *Formica*; Francour and Buschinger 1985 for *Formicoxenus*; Mackay 1993 for *Dolichoderus*; Mackay 2000 for *Temnothorax*; Hansen and Klotz 2005 for *Camponotus*), the faunas of a number of relevant regions have received treatments (Gregg 1972; Yensen et al. 1977; Wheeler and Wheeler 1986; 1988, 1997; Naumann et al. 1999; Mackay and Mackay 2002; Heron 2005; Clark and Blom 2007), and a few ecological studies have focused on Albertan ants (e.g. Wu and Wong 1987; Savolainen and Deslippe 2001; Perry 2004; Newton et al. 2011). In addition, a number of overarching treatments have been published that deal with ants globally (Hölldobler and Wilson 1990; Bolton 1994, 1995), in North America (Fisher and Cover 2007), or in urban environments in North America and Europe (Klotz et al. 2008). Work in Alberta over the past 45 years, and especially the recent field studies of Glasier (2012), have more than doubled the number of species known from the province, making it worthwhile to provide a key to this ecologically important fauna. The key was initially based on a variety of existing publications (Creighton 1950; Wilson 1955; Wheeler and Wheeler 1963; Francoeur 1973; Francoeur and Buschinger 1985; Wheeler and Wheeler 1986; Mackay and Mackay 2002; Hansen and Klotz 2005), and modified for Alberta, based on our experience with the fauna.

Materials

Ants were collected at a variety of sites around Alberta. Large numbers were examined from areas associated with three ecological studies: the EMEND forestry project in the Peace River area of northwestern Alberta (http://www.emend.rr.ualberta.ca), Glasier's studies of ants on central Albertan sand hills (summarized in Glasier 2012), and a study by Newton et al. (2011) on native fescue grassland from east-central Alberta. In addition, collections were examined at the Royal Alberta Museum, the University of Calgary Entomological Collection, and the E. H. Strickland Entomological Museum at the

doi:10.3752/cjai.2013.22

University of Alberta. Vouchers of each species collected will be deposited in the E. H. Strickland collection, and additional specimens have been retained in the personal collection of James Glasier.

Overview of the Fauna

Based on published records and the collections described above, there are 93 species (one of which includes two named subspecies) in 16 genera and three subfamilies known from Alberta (Table 1 and Figures 1-94). By far the most species-rich genus is *Formica*, with 38 recorded species. Other species-rich genera include *Camponotus*, *Lasius*, *Myrmica*, and *Leptothorax*. Several rare or geographically restricted genera include *Dolichoderus*, *Solenopsis*, *Manica*, and *Pogonomyrmex*. There are four putatively endemic species in Alberta: *Leptothorax athabasca* Buschinger and Schulz, *Leptothorax pochahontas* (Buschinger), *Leptothorax faberi* Buschinger, and *Temnothorax fragosus* (Mackay and Buschinger), all apparently restricted to the Rocky Mountains. Of the 93 species of ants in Alberta, 91 are indigenous and two, *Monomorium pharaonis* (Linnaeus) and *Brachymyrmex obscurior* Forel, are introduced and are almost solely found within human buildings (Klotz et al. 2008).

Taxonomic Issues

Several genera likely contain more species in Alberta than are listed. Some may be undescribed, while others are simply difficult to distinguish and are thus not yet confirmed for the province. These issues are briefly summarized here.

Leptothorax: *Leptothorax* species are difficult to identify confidently, as the diagnostic characteristics for many species are poorly defined (Fischer and Cover 2007; Buschinger and Schultz 2008). Even among the species we chose to recognize here, many individuals will be difficult to place correctly. In addition, the taxon we refer to as *Leptothorax muscorum* (= "*L. canadensis*" (Nylander), a name proposed for North American members of this Holarctic taxon) may represent several species in Alberta, including *L. pocahontas*.

Temnothorax: like *Leptothorax*, *Temnothorax* from the northern Nearctic is relatively poorly known (Mackay and Buschinger 2002; Buschinger and Schultz 2008). It is possible there are more species waiting to be recognized in Alberta.

Myrmica: this genus contains several species that are morphologically similar (Fischer and Cover 2007). It is probable that because of limited taxonomic work, and limited collecting, more species exist in Alberta. Two potentially new species (referred to here as *Myrmica* ab01 and *Myrmica* code AF-eva), are morphologically distinct from known species, and were included in the key as tentatively different until further descriptions can be made. *Myrmica* ab01 is similar to *Myrmica crassirugis* but possesses distinctly upturned propodeal spines. *Myrmica* code AF-eva is similar to *Myrmica americana,* but possesses smaller lamina on the basal bend of its scape. As the North American *Myrmica* are currently being revised by Dr. André Francoeur, at University of Quebec (personal communication), these potentially new species may be described by him.

Formica: the genus *Formica* contains six species groups and numerous species that are difficult to separate from one another (Fisher and Cover 2007). Traits that cannot be seen without a high resolution dissecting microscope, regional variation within species, and differences relying on subtle characters based on setae and/or pubescence often make *Formica* difficult to identify to species with any confidence. In this key we try to simplify these difficulties, but comparison with identified material, and familiarisation by working with large numbers of specimens is the best way to see the differences present between similar species of this genus. We recognize a difference between subspecies *F. oreas oreas* and *F. oreas comptula*; however, more work is needed before determining if they are conspecific, are indeed subspecies, or deserve further taxonomic separation. In addition some specialists informally suspect that *F. obscuripes* and *F. planipilis* may hybridize or be conspecific, though we chose to keep them separate for this key as they are well established in the literature (Creighton 1950; Wheeler and Wheeler 1963; Wheeler and Wheeler 1986; Mackay and Mackay 2002).

Preparing Specimens for Use with this Key

The key is intended to allow identification of worker-caste ant specimens from Alberta, but careful specimen preparation will facilitate identification. The following tips should ensure that adequate material is acquired at the time of collection. A stereo microscope with at least 50X magnification is required to see many of the characteristics mentioned in the key, and careful experimentation with lighting, including diffusion, may be required as well.

- Collect a range of worker sizes and multiple specimens (minimum of five recommended).
- Specimens in ethanol can be difficult to identify. It is best for the specimens to be pinned, pointed (glued to a triangular card) and dry, so that structures such as erect setae are easier to see.
- When pointing specimens make sure the mandibles are open so you can see all mandibular teeth. For the genera *Lasius, Temnothorax* and *Leptothorax* this is particularly important.
- For identification of *Camponotus* species, major

workers are required (Hansen and Klotz 2005); however it is important to collect all castes, especially when dealing with arboreal species such as *Camponotus nearcticus*, whose majors can easily be confused with minors from larger *Camponotus* species.

- For identification of *Formica fusca* group specimens there is a couplet in the key where some dissection is needed. This dissection is best done before the specimen is pointed. Remove the posterior four legs including the coxae, and then mount the specimen on its side; this will allow for structures required for identification to be seen.
- For identification of *Lasius*, workers of several species are very similar (especially in the subgenus *Acanthomyops*). Characters of many of these species are most evident and less variable in the larger workers (Wilson 1955; Mackay and Mackay 2002), especially for mandibular tooth characters; therefore smaller specimens of a species can easily be confused. To alleviate any confusion it is best to examine multiple specimens from a colony.
- For identification of *Myrmica* species, when using antennal characters it is best to orient the antenna as pictured in Figs. 14a and 14b. The base of the scape should be oriented perpendicular to the head so as to reveal laminal characters in posterior and anterior views.

Table 1. List of species of Formicidae known from Alberta:

Asterisks (*) indicate ant species that have been reported from Alberta in the literature, but have not been encountered by the authors.

Subfamily Dolichoderinae

Genus *Dolichoderus*
- *Dolichoderus taschenbergi* (Mayr) 1866

Genus *Tapinoma*
- *Tapinoma sessile* (Say) 1836

Subfamily Formicinae

Genus *Brachymyrmex*
- *Brachymyrmex depilis* Emery 1893
- *Brachymyrmex obscurior* Forel 1893

Genus *Camponotus*
- *Camponotus herculeanus* (Linnaeus) 1758
- *Camponotus laevigatus* (Smith) 1858 (Hansen and Klotz 2005*)
- *Camponotus modoc* Wheeler 1910
- *Camponotus nearcticus* Emery 1893
- *Camponotus novaeboracensis* (Fitch) 1855
- *Camponotus vicinus* Mayr 1870

Genus *Formica*
- *Formica accreta* Francoeur 1973
- *Formica adamsi* Wheeler 1909
- *Formica altipetens* Wheeler 1913
- *Formica aserva* Forel 1901
- *Formica argentea* Wheeler 1902
- *Formica bradleyi* Wheeler 1913
- *Formica canadensis* Santschi 1914
- *Formica dakotensis* Emery 1893
- *Formica densiventris* Viereck 1903
- *Formica emeryi* Krausse 1926
- *Formica fossaceps* Buren 1942
- *Formica fusca* Linnaeus 1758
- *Formica glacialis* Wheeler 1908
- *Formica hewitti* Wheeler 1917
- *Formica impexa* Wheeler 1905
- *Formica integroides* Wheeler 1913
- *Formica lasioides* Emery 1893
- *Formica limata* Wheeler 1913
- *Formica microgyna* Wheeler 1903
- *Formica montana* Wheeler 1910
- *Formica neoclara* Emery 1893
- *Formica neogagates* Viereck 1903
- *Formica neorufibarbis* Emery 1893
- *Formica obscuripes* Forel 1886
- *Formica obscuriventris* Mayr 1870
- *Formica obtusopilosa* Emery 1893
- *Formica opaciventris* Emery 1893
- *Formica oreas* Wheeler 1903
- *Formica oreas comptula* Wheeler 1913
- *Formica perpilosa* Wheeler 1913
- *Formica planipilis* Creighton 1940
- *Formica podzolica* Francoeur 1973
- *Formica puberula* Emery 1893
- *Formica ravida* Creighton 1940
- *Formica rubicunda* Emery 1893
- *Formica subintegra* Wheeler 1908
- *Formica subnitens* Creighton 1940
- *Formica subpolita* Mayr 1886
- *Formica ulkei* Emery 1893

Genus *Lasius*
- *Lasius alienus* (Förster) 1850
- *Lasius coloradensis* Wheeler 1917
- *Lasius crypticus* Wilson 1955
- *Lasius fallax* Wilson 1955
- *Lasius flavus* (Fabricius) 1781
- *Lasius latipes* (Walsh) 1863
- *Lasius neoniger* Emery 1893
- *Lasius niger* (Linnaeus) 1758
- *Lasius pallitarsis* (Provancher) 1881

Lasius subglaber Emery 1893
Lasius subumbratus Viereck 1903
Lasius umbratus (Nylander) 1846
Genus *Polyergus*
Polyergus breviceps Emery 1893

Subfamily Myrmecinae
Genus *Formicoxenus*
Formicoxenus hirticornis (Emery) 1895
Formicoxenus quebecensis Francoeur 1985
Formicoxenus provancheri (Emery) 1895
Genus *Harpagoxenus*
Harpagoxenus canadensis Smith 1939
Genus *Leptothorax*
Leptothorax athabasca Buschinger and Schultz 2008
Leptothorax faberi Buschinger 1983 (Buschinger 1983*)
Leptothorax muscorum (Nylander) 1846
Leptothorax pocahontas (Buschinger) 1979 (Buschinger 1979*)
Leptothorax retractus Francoeur 1986
Leptothorax wilsoni Heinze 1989 (Heinze et al. 1995*)
Genus *Manica*
Manica hunteri (Wheeler) 1914
Manica invidia Bolton* 1895 (Sharplin 1966)
Genus *Monomorium*
Monomorium minimum (Buckley) 1867
Monomorium pharaonis (Linnaeus) 1758
Genus *Myrmica*
Myrmica **ab01** (near *Myrmica crassirugis*)
Myrmica code AF-eva (near *Myrmica americana*)
Myrmica alaskensis Wheeler 1917
Myrmica americana Weber 1939
Myrmica brevispinosa Wheeler 1917
Myrmica crassirugis Francoeur 2007
Myrmica detritinodis Emery 1921
Myrmica fracticornis Forel 1901
Myrmica incompleta Provancher 1881
Myrmica latifrons Stärcke 1927
Myrmica lobifrons Pergande 1900
Myrmica nearctica Weber 1939
Genus *Pogonomyrmex*
Pogonomyrmex occidentalis (Cresson) 1865
Pogonomyrmex salinus Olsen 1934
Genus *Solenopsis*
Solenopsis molesta (Say) 1836
Genus *Temnothorax*
Temnothorax ambiguus (Emery) 1895
Temnothorax fragosus (Mackay and Buschinger) 2002
Temnothorax rugatulus (Emery) 1895

Glossary

Some of the terms used in ant identification may be unfamiliar, even to those who work on other insect groups. Definitions for this glossary are based on a variety of existing definitions from a wide range of entomological sources (Torre-Bueno et al. 1989; Hölldobler and Wilson 1990; Bolton 1994; Mackay and Mackay 2002; Fisher and Cover 2007). Terms used in the key are defined below.

Antenna: paired, segmented sensory appendages attached to the front of the head.

Antennal fossa: depressed area around the antennal socket.

Antennal socket: articulation of the antenna with the head.

Apex: tip, most distal point (plural= apices).

Apical club: antennae have an apical club when the distal (terminal) segments are enlarged relative to more basal segments.

Appressed setae: setae that lie against, or run almost parallel to, the cuticle of an ant.

Basal tooth: the basalmost tooth along the chewing margin of the mandible, closest to the anterior margin of the clypeus.

Carinate: having multiple carinae (ridges).

Clavate setae: setae that are expanded at their apices.

Clypeus: the anterior median sclerite of an ant head. The anterior margin of the clypeus forms the anterior margin of the head in frontal view.

Clypeal fossa: depression near the posterior margin of the clypeus, formed from the lateral “wings” or sides of the clypeus.

Concolourous: head, mesosoma and gaster are all the same colour.

Decumbent setae: setae that stand at an angle of between 10-40 degrees from the cuticle of ant.

Erect setae: setae which stand at higher than a 40 degree angle from the cuticle of ant.

Flexor surfaces: the surfaces of the tibia and femur that can touch each other when the leg bends.

Frontal carinae: a pair of parallel or almost parallel ridges, medial to the antennal sockets, originating directly posterior to the clypeus on the head of an ant.

Frontal lobes: lobes formed when frontal carinae extend laterally over the antennal fossae.

Frontal triangle: a triangular area dorsal to the clypeus and between the frontal carina.

Full face view: anterior view in which the midpoints of the occipital margin, lateral margin, and clypeus are in the same focal plane.

Funiculus: the apical segments of antenna, after the first basal segment.

Gaster: terminal four or five segments of the abdomen, posterior to the petiole and/or postpetiole.

Gena: the area of the head between the compound eye and the mandible.

Head length: measured from the anterior midline of the clypeus to the posterior midline of the occipital margin; does not include the mandibles.

Infuscated: darkened, with a blackish tinge.

Inquiline: living in another ant’s nest; either commensally or parasitically.

Major: the larger castes of an ant species, excluding the queen.

Mesosomal profile: dorsal profile of the mesosoma, as seen in lateral view.

Mesosoma: the middle of the three main body parts of an ant. Includes the thorax and the propodeum.

Mesonotum: dorsal tergite of the mesothorax.

Metasternum: the posteroventral sclerite of the propodeum.

Metanotal region: the area where mesonotum and propodeum meet, representing the vestiges of a tergite called the metanotum.

Microreticulate: with a network of very fine ridges.

Minor: the smaller castes of an ant species.

Monomorphic: having one size and/or morphological caste.

Occipital margin: the posterior margin of the head.

Peduncle: an anteriorly elongated narrowing of the petiole.

Petiole: the anterior segment (and sometimes the only segment) of the ant waist, consisting of abdominal segment 2.

Polymorphic: having multiple sizes and/or morphological castes.

Postpetiole: the posterior segment (not present in all ant species) of the ant waist, consisting of abdominal segment 3.

Profemora: the femora of the anterior pair of legs.

Pronotum: the dorsal sclerite of the prothorax.

Propodeal spines: spines on the dorsum of the propodeum.

Propodeum: the first abdominal segment, fused to the thorax. Forms part of the mesosoma.

Prothorax: the first thoracic segment.

Psammophore: an array of long setae, forming a basket, on the ventral surface of the head.

Pubescence: short fine setae which are appressed along the cuticle.

Punctate: with numerous fine pits.

Rugae: wrinkle-like ridges, often in parallel.

Scape: elongate basal segment of antenna.

Sclerite: an integumental plate of the exoskeleton.

Striae: impressed lines.

Tergite: dorsal sclerite of a segment.

Truncate setae: setae that are thick and squared off at the apex.

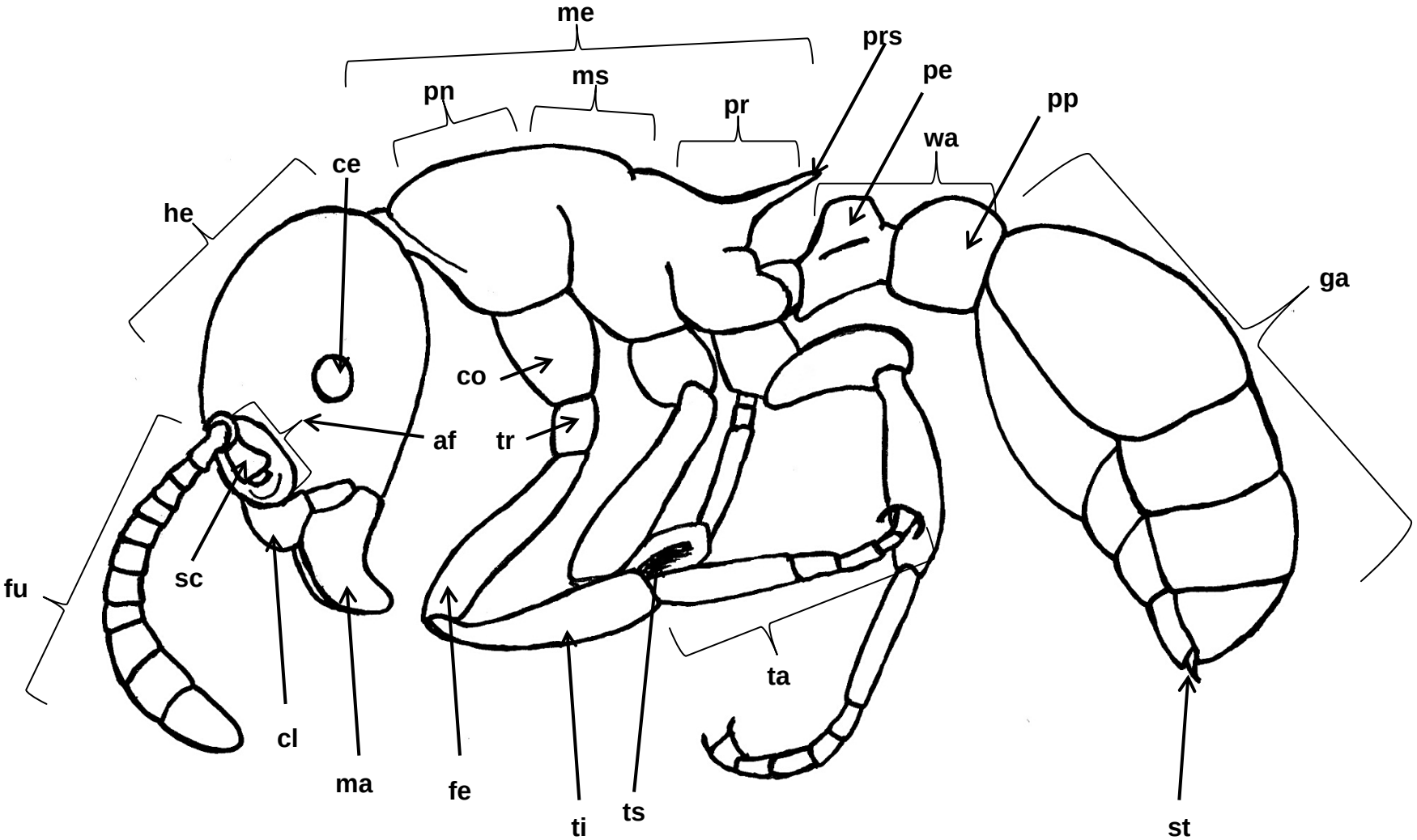


Figure 1. Lateral diagram showing parts of a *Myrmica alaskensis* Wheeler worker from the subfamily Myrmicinae. Labels: af: antenna fossa; ce: compound eye; cl: clypeus; co: coxa; fe: femur; fu: funiculus; ga: gaster; ma: mandible; me: mesosoma; ms: mesonotum; pe: petiole; pp: postpetiole; pn: pronotum; pr: propodeum; prs: propodeal spine; sc: scape; st: stinger; ta: tarsus, composed of tarsomeres; ti: tibia; tr: trochanter; ts: tibial spur; wa: waist.

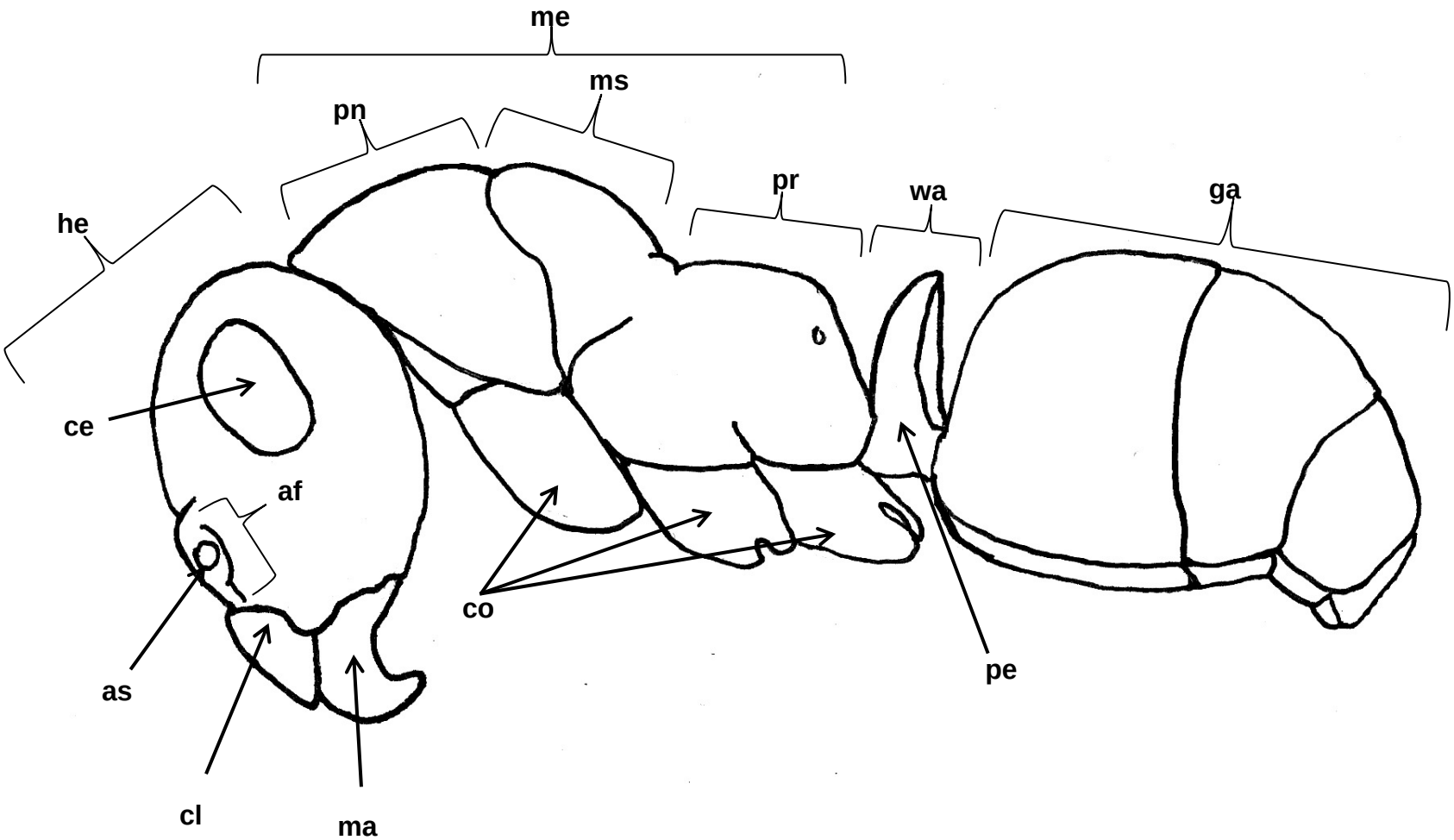


Figure 2. Lateral diagram showing parts of a *Formica podzolica* Francoeur worker from the subfamily Formicinae (antenna and legs not shown). Labels: af: antennal fossa; as: antennal socket; ce: compound eye; cl: clypeus; co: coxa; ga: gaster; he: head; ma: mandible; me: mesosoma; ms: mesonotum; pe: petiole; pn: pronotum; pr: propodeum; wa: waist.

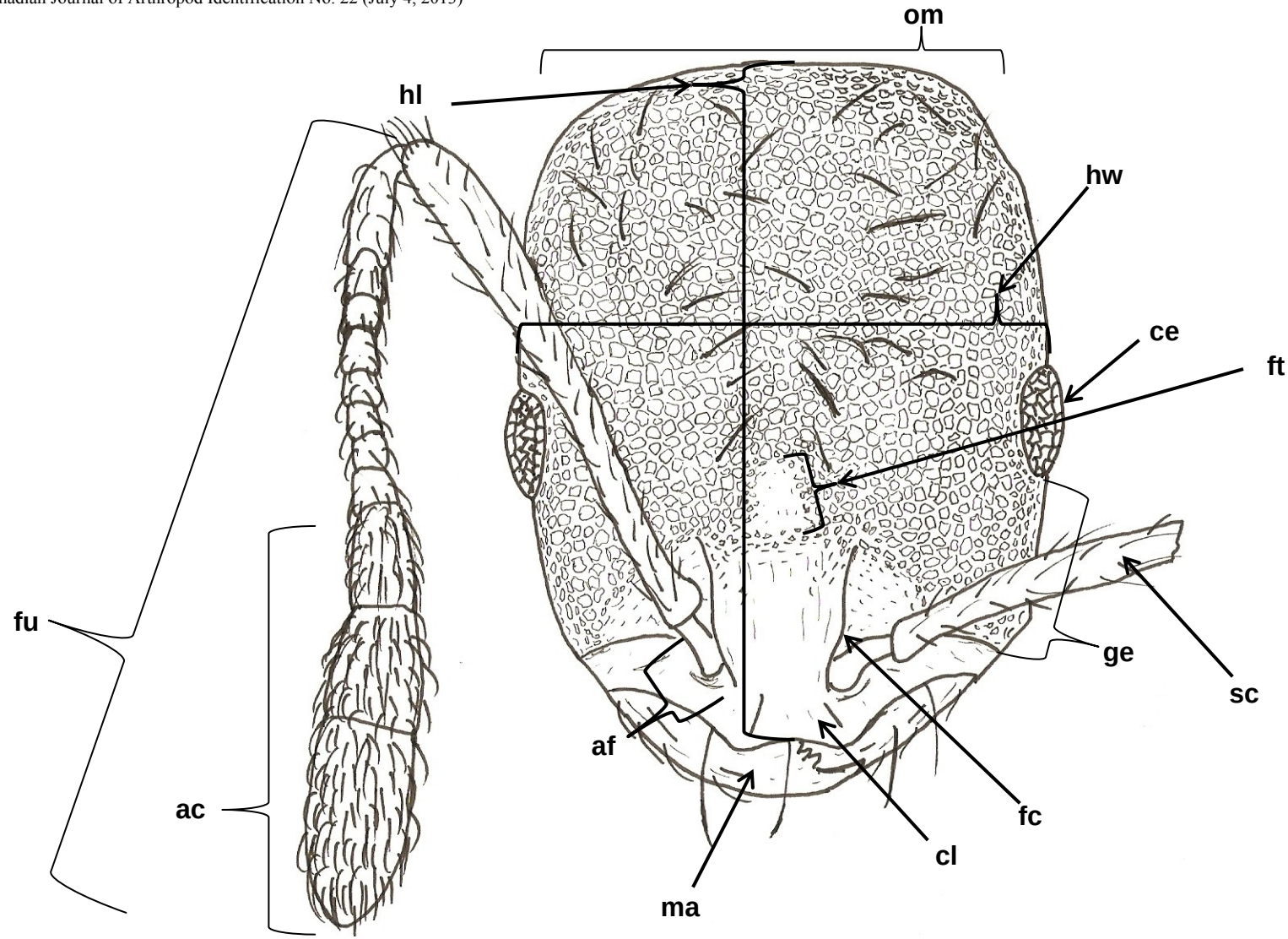
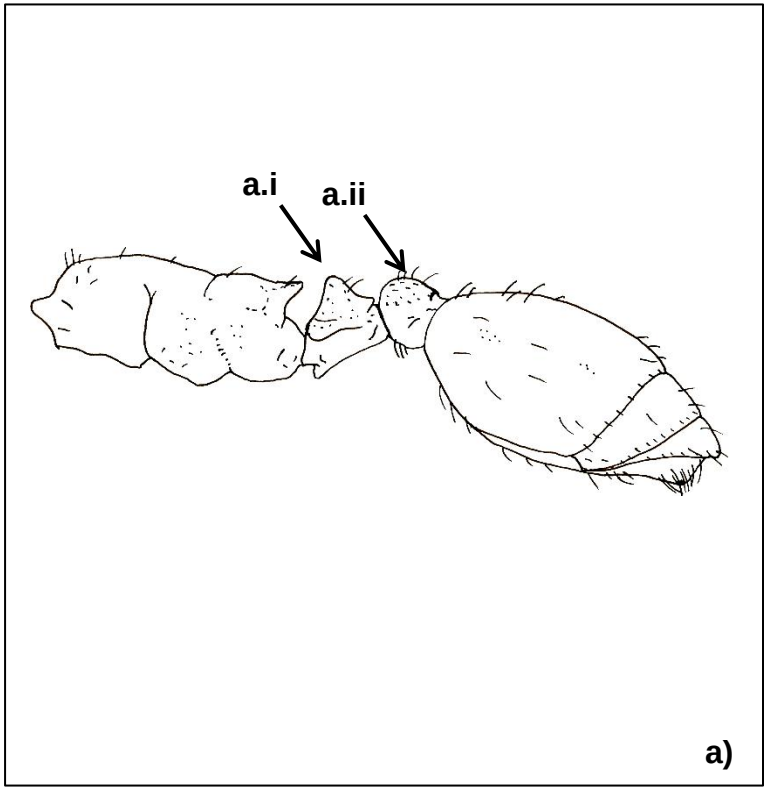


Figure 3. Head view diagram of a *Monomorium pharaonis* (Linnaeus) worker from the subfamily Myrmicinae: left funiculus not shown. Labels: ac: antennal club; af: antennal fossa; ce: compound eye; cl: clypeus; fc: frontal carina; ft: frontal triangle; fu: funiculus; ge: gena; hl: head length; hw: head width; ma: mandible; om: occipital margin; sc: scape.



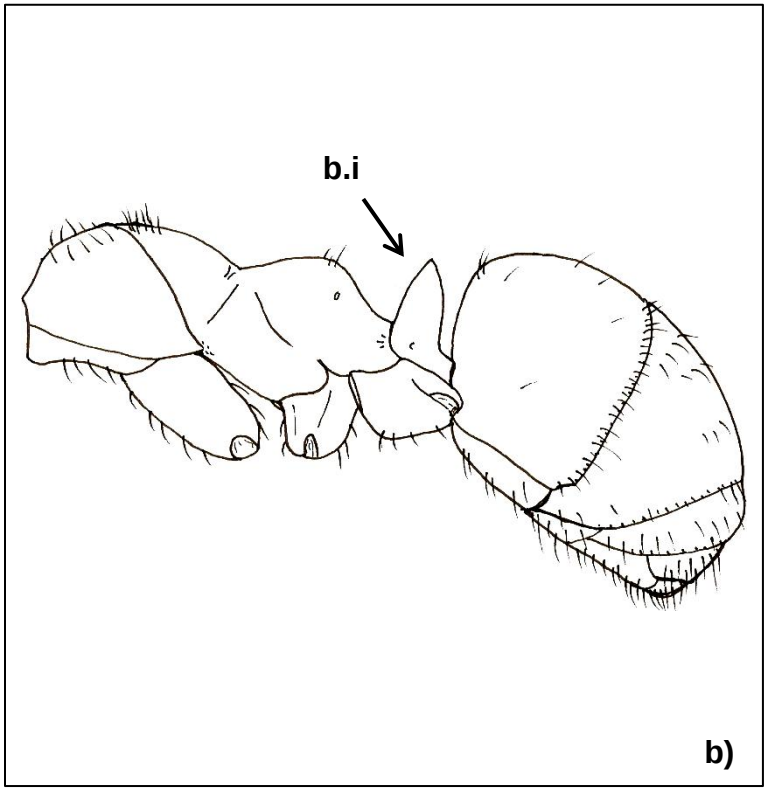


Figure 4.

1	Waist consisting of petiole (a.i) and postpetiole (a.ii) (abdominal segment 3, which is separated from the petiole in front and abdominal segment 4 behind) (a). Stinger present, though not always obvious. (Subfamily Myrmicinae).	2
1’	Waist consisting of one segment, the petiole (b.i). Postpetiole absent, stinger absent.	33

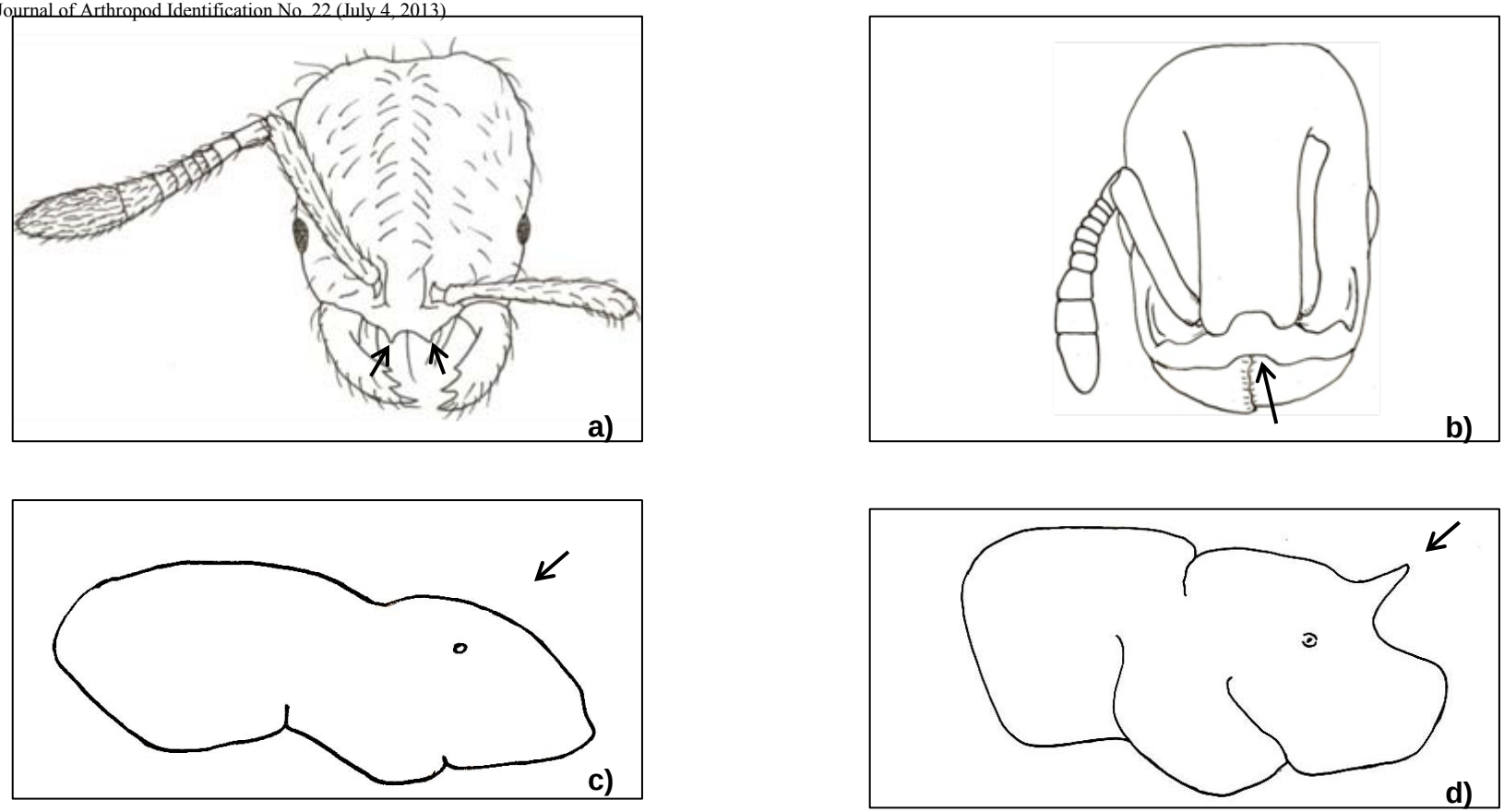
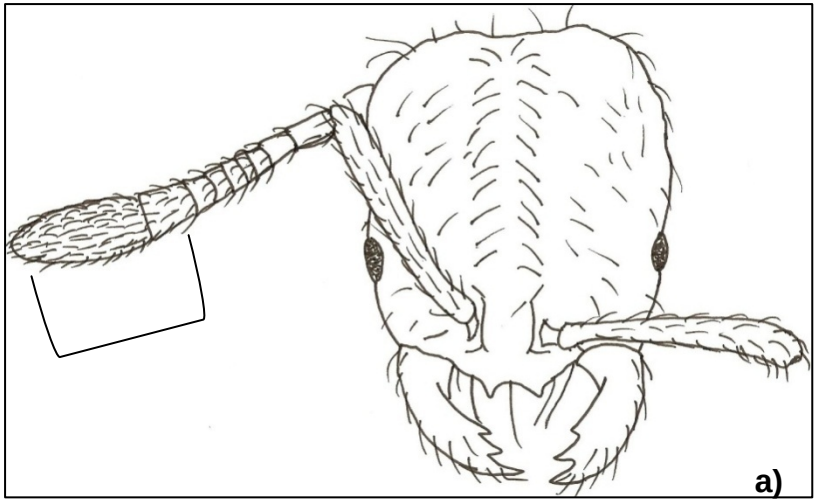


Figure 5.

2 (1)	Clypeus bidentate (a). Propodeum without spines (c).	3
2’	Clypeus not bidentate but may be notched (b). Propodeum with or without spines (c or d).	5



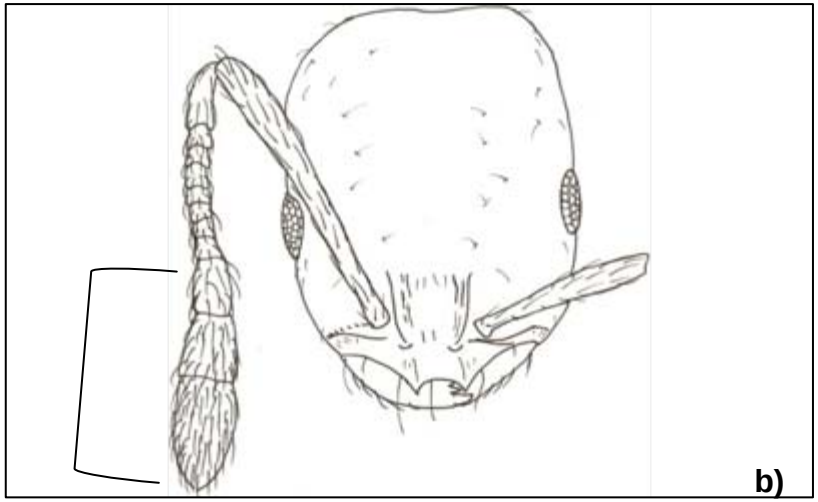
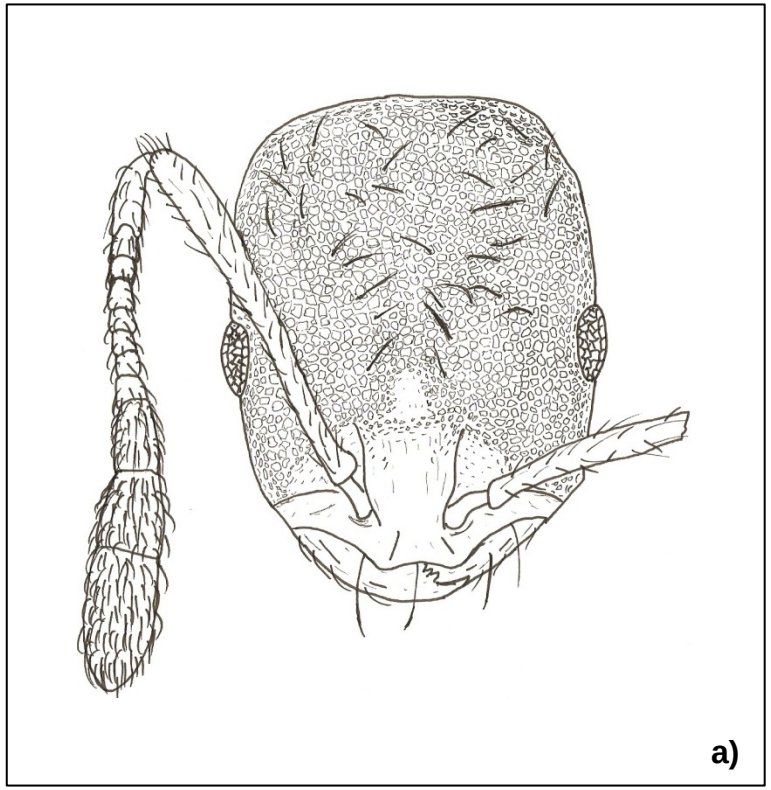


Figure 6.

3 (2)	Antenna with 10 segments and last two segments forming the apical club (a). (Genus *Solenopsis*).	*Solenopsis molesta Say*
3’	Antenna with 12 segments and last three segments forming the apical club (b). (Genus *Monomorium*).	4



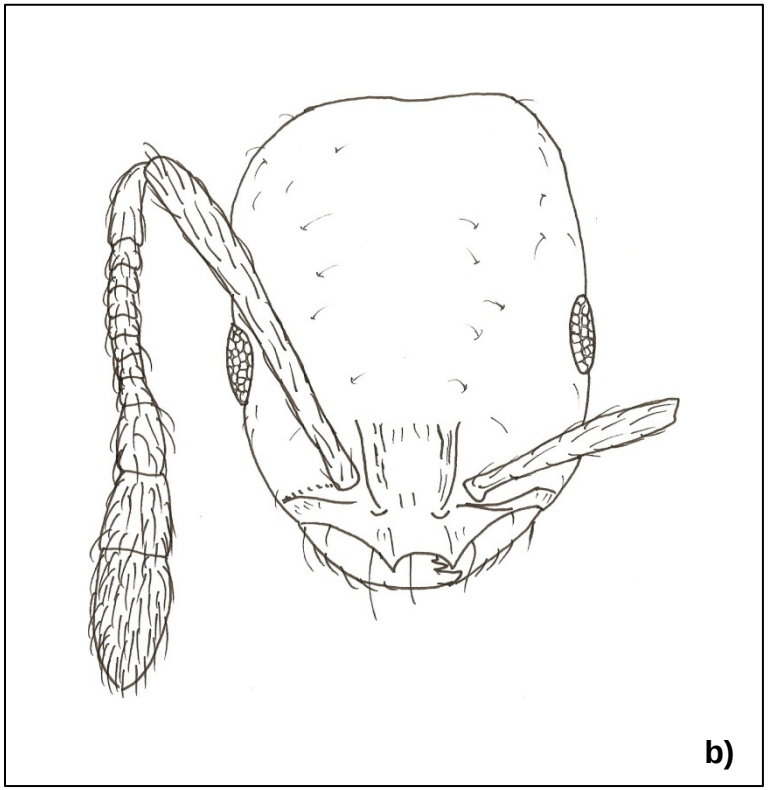
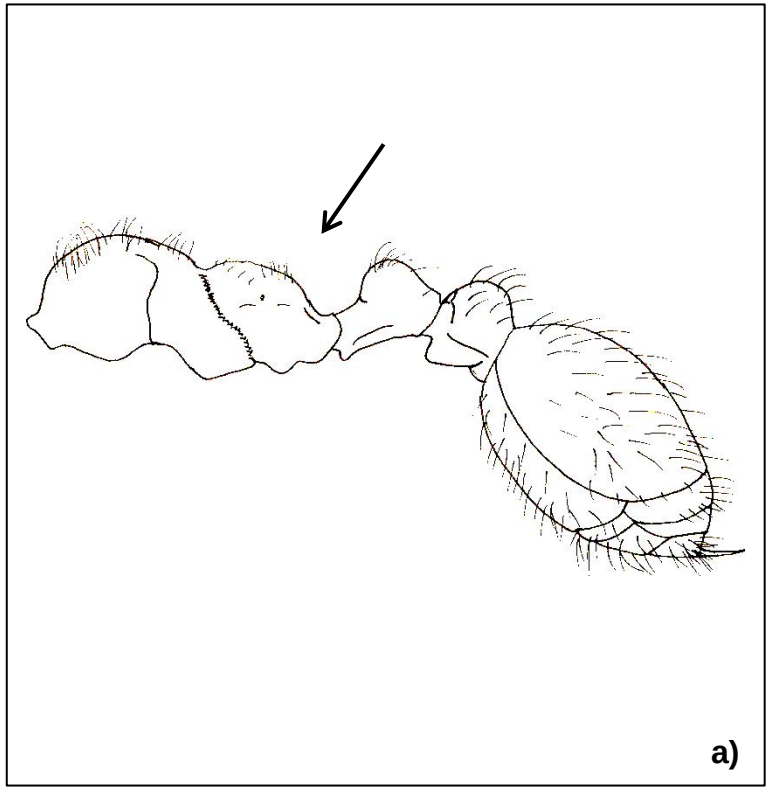


Figure 7.

4 (3)	Head and thorax heavily microreticulate and dull (a). Colour reddish yellow with slightly darker gaster.	*Monomorium pharaonis* (Linnaeus)
4’	Head and thorax smooth and shiny (b). Concolourous dark brown.	*Monomorium minimum* (Buckley)



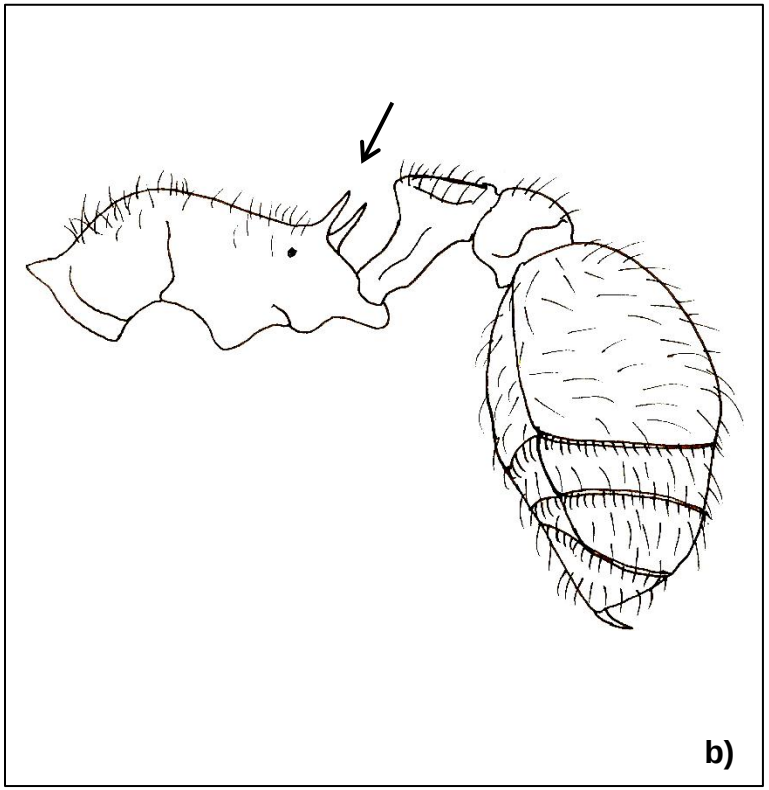
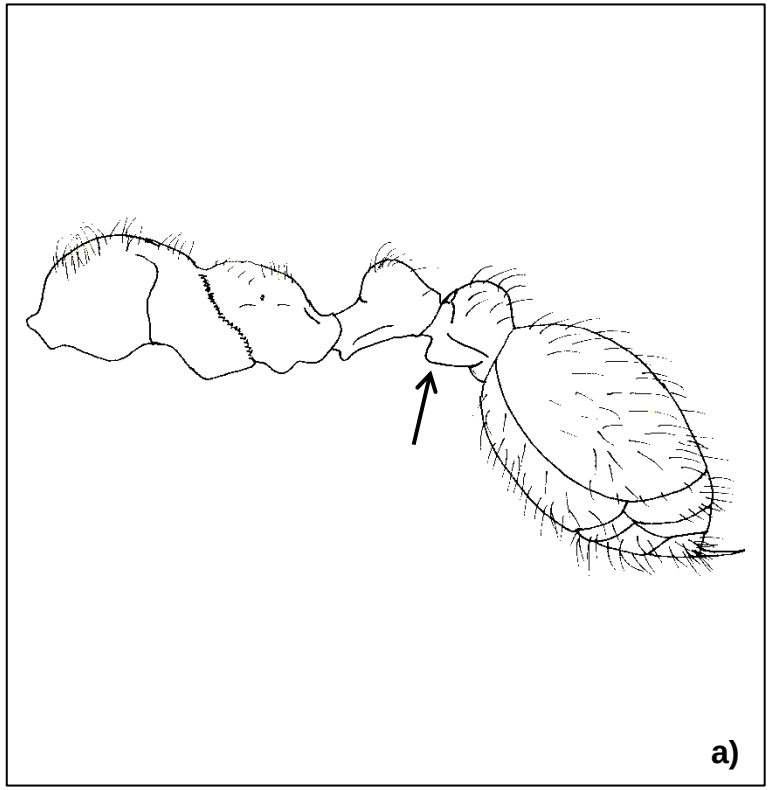


Figure 8.

5 (2)	Propodeum without spines (a). (Genus *Manica*).	6
5’	Propodeum with spines (b).	7



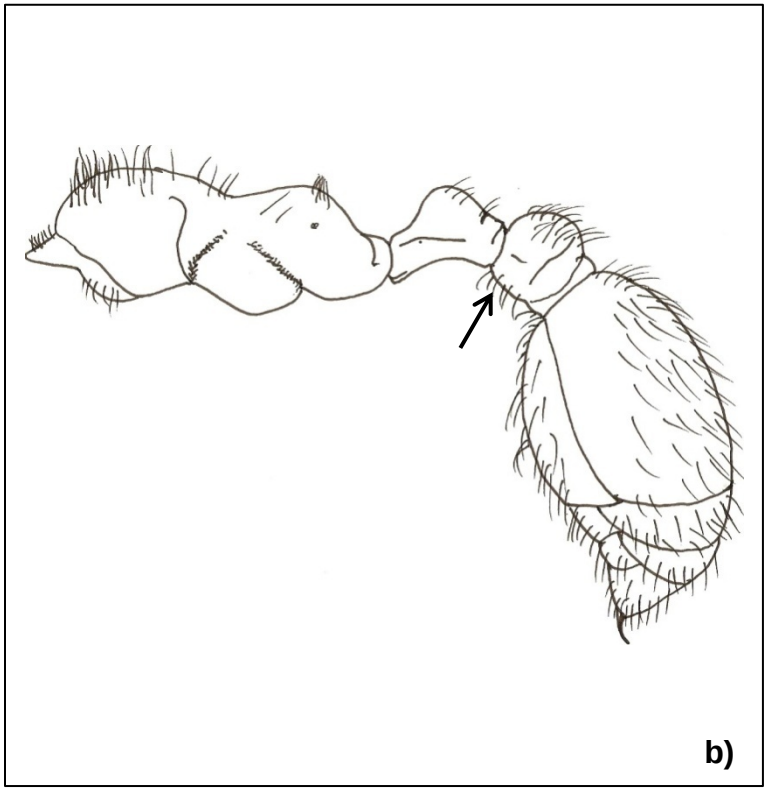
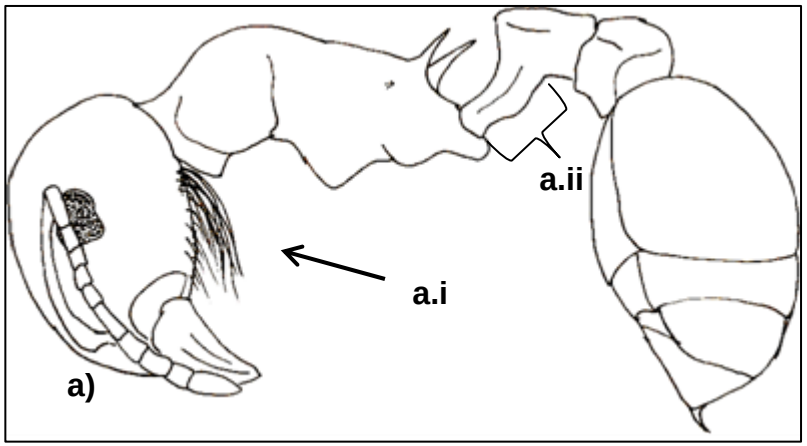


Figure 9.

6 (5)	Lobed projection on anterior ventral part of postpetiole (a).	*Manica hunteri* (Wheeler)
6’	Postpetiole without ventral projection (b).	*Manica invidia* Bolton



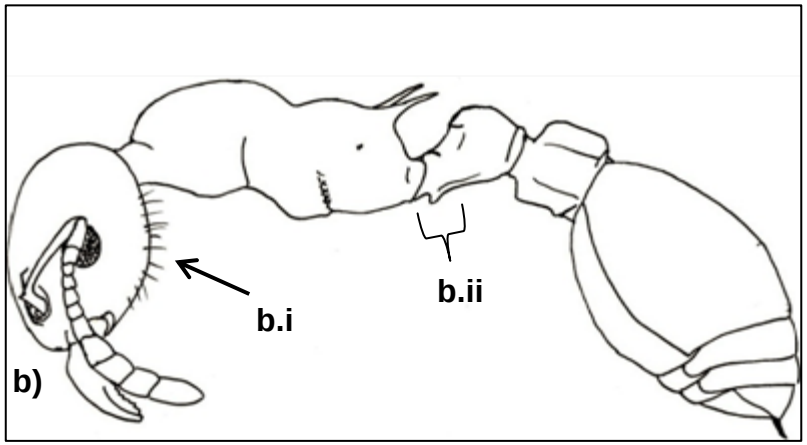
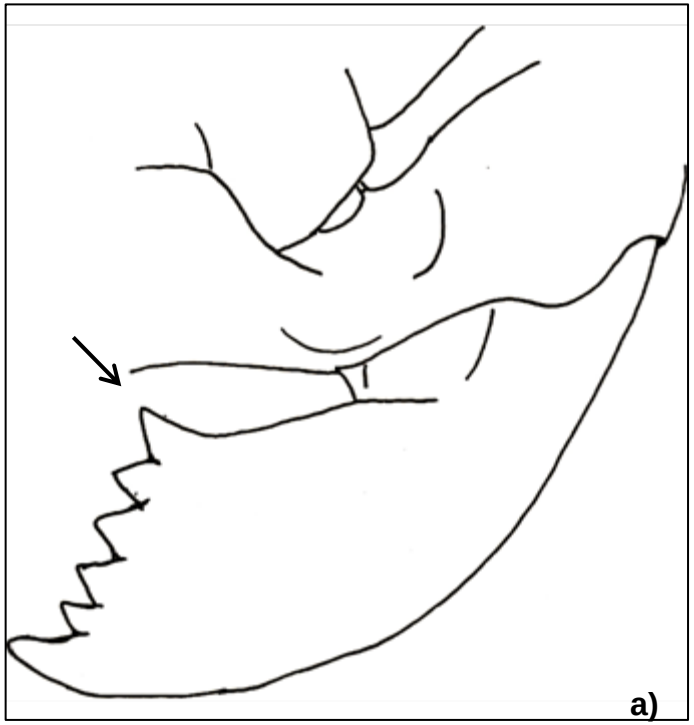


Figure 10.

7 (5)	Psammophore present (a.i), petiole with elongate anterior peduncle (a.ii) (Genus *Pogonomyrmex*).	8
7’	Psammophore not present (b.i). Petiole without elongate peduncle (b.ii).	9



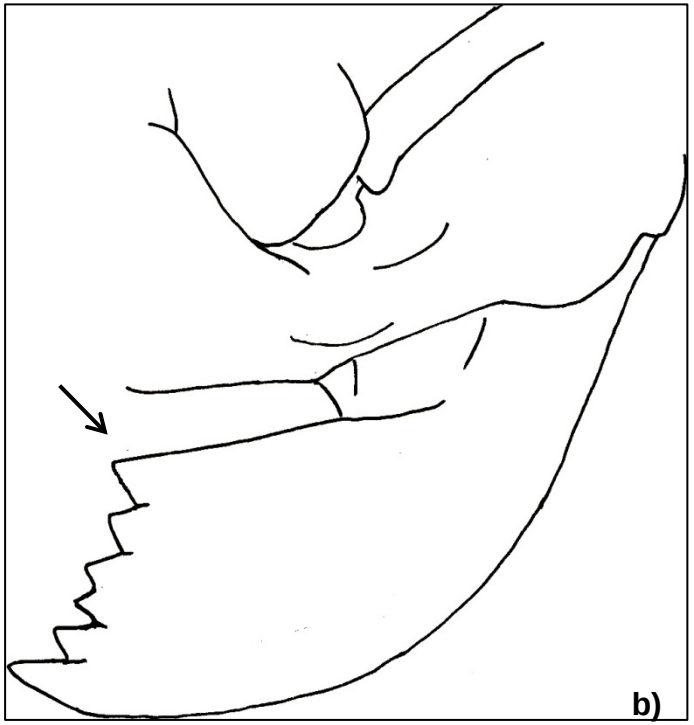


Figure 11.

8 (7)	Basal tooth of mandible deflected posteriorly (a).	*Pogonomyrmex occidentalis* (Cresson)
8’	Basal tooth of mandible with same orientation as other teeth (b).	*Pogonomyrmex salinus* Olsen

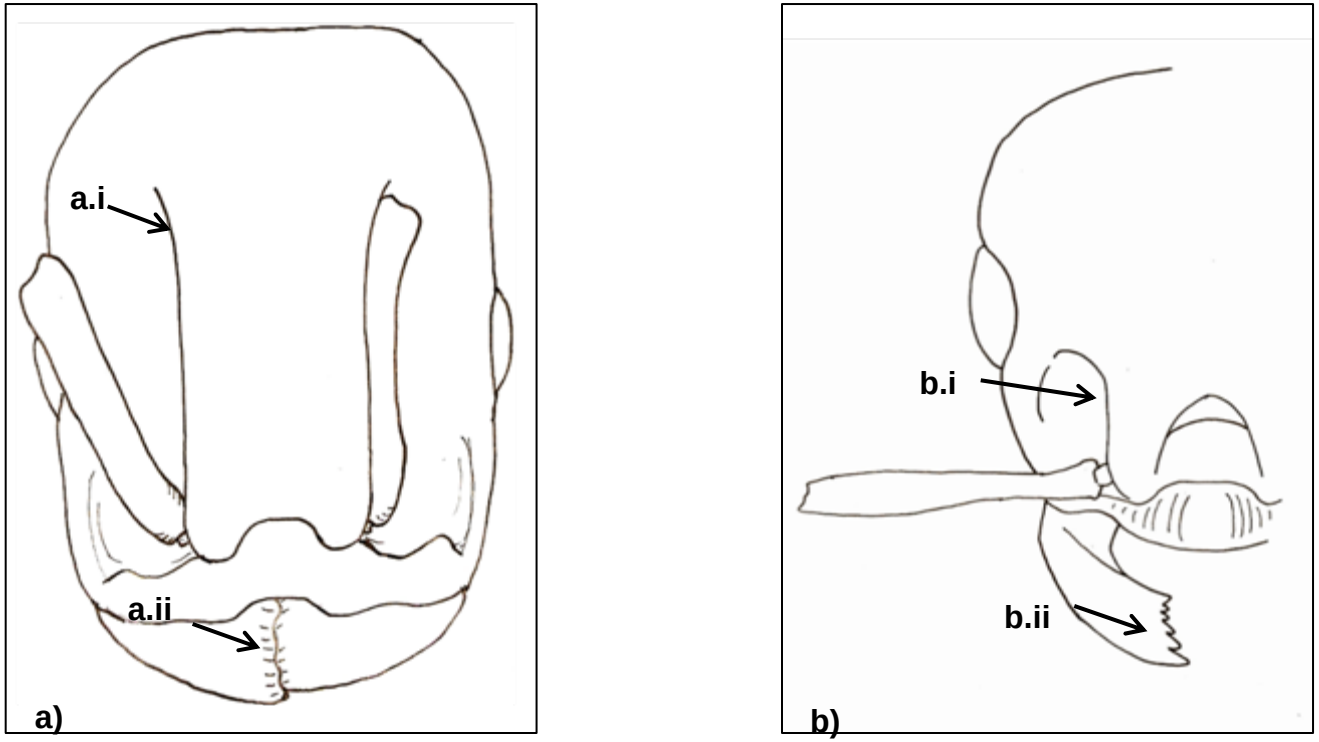


Figure 12.

9 (7)	Frontal carinae extending past eyes (a.i). Mandibles without teeth (a.ii). (Genus *Harpagoxenus*)	*Harpagoxenus canadensis* Smith
9’	Frontal carinae not extending past eyes (b.i). Mandibles usually with (but sometimes without) teeth (b.ii).	10

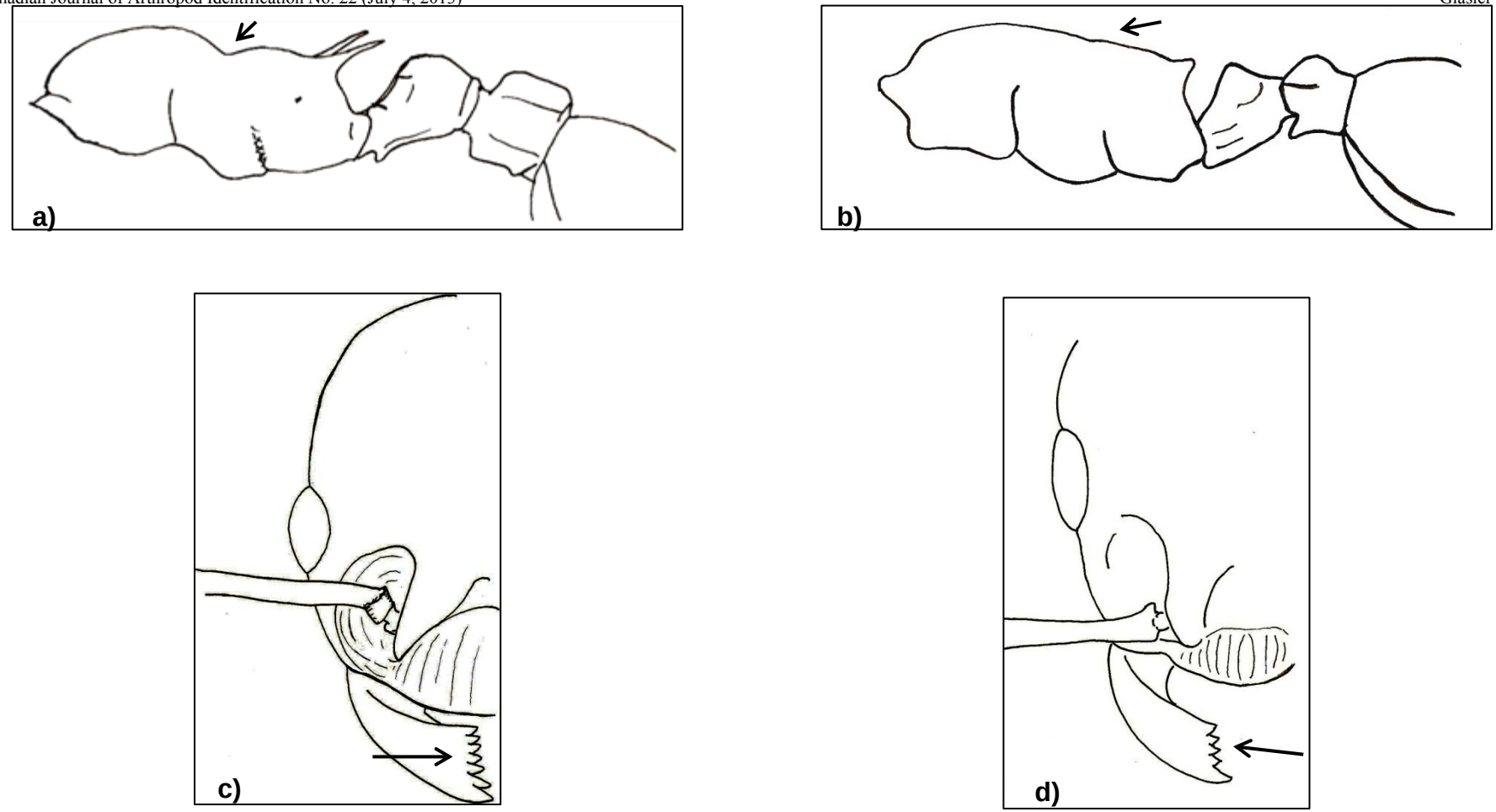


Figure 13.

10 (9)	Metanotal region weakly to moderately notched, interrupting mesosomal profile (a). Mandible with seven or more teeth (c). Medium sized ants (usually 4-6 mm) (Genus *Myrmica*).	11
10’	Metanotal region not as deeply notched; mesosomal profile flat to convex (b). Mandible with six or fewer teeth (d). Smaller ants (usually ~2 mm).	22

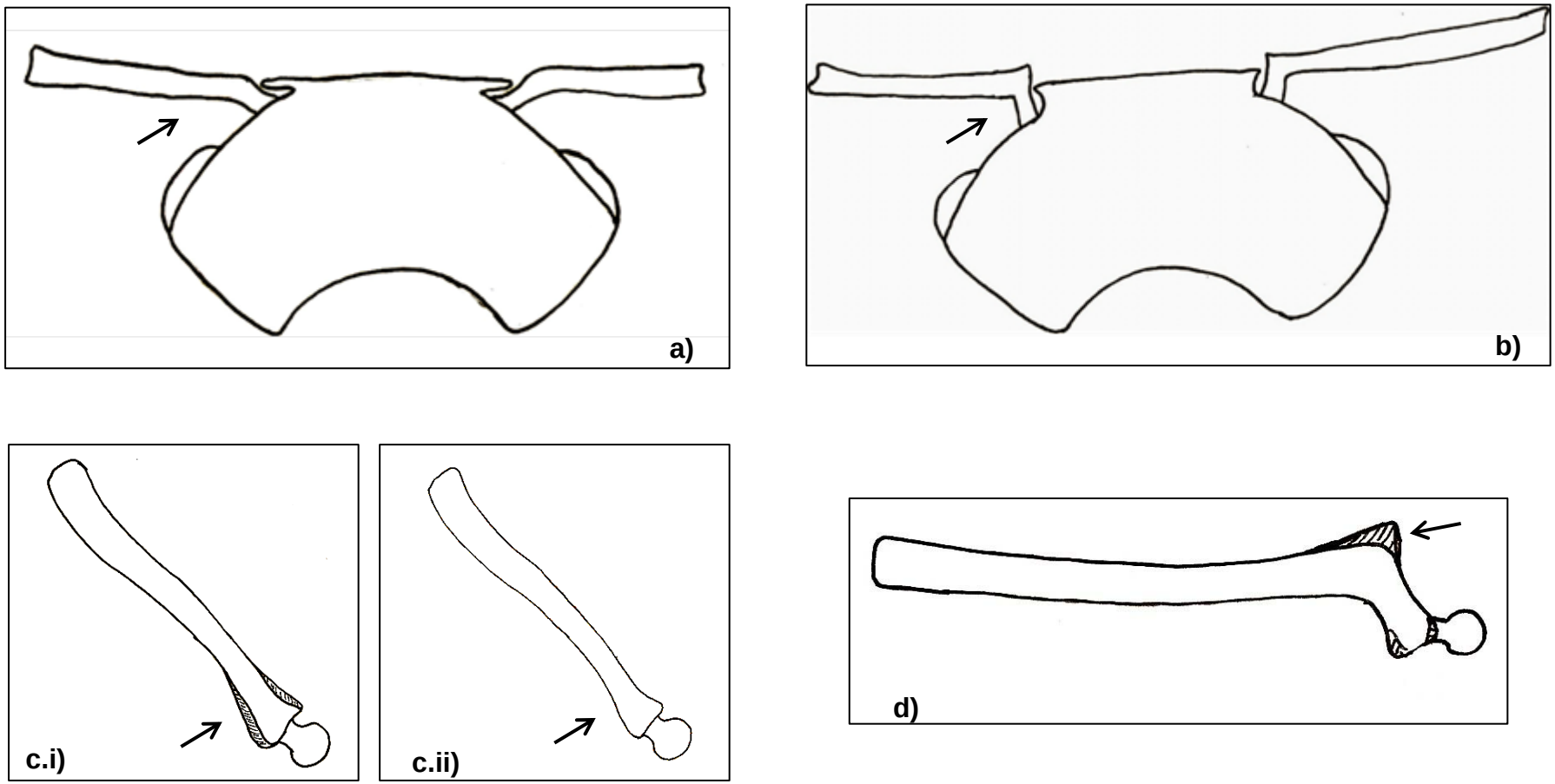


Figure 14.

11 (10)	Viewing head from the posterior, scape gradually curved posterobasally (a). With (c.i) or without (c.ii) a postero-lateral dark ridge before bend.	12
11’	Viewing head from the posterior, scape more angular posterobasally (b). With a lamina, thickening, or ridge (d).	15

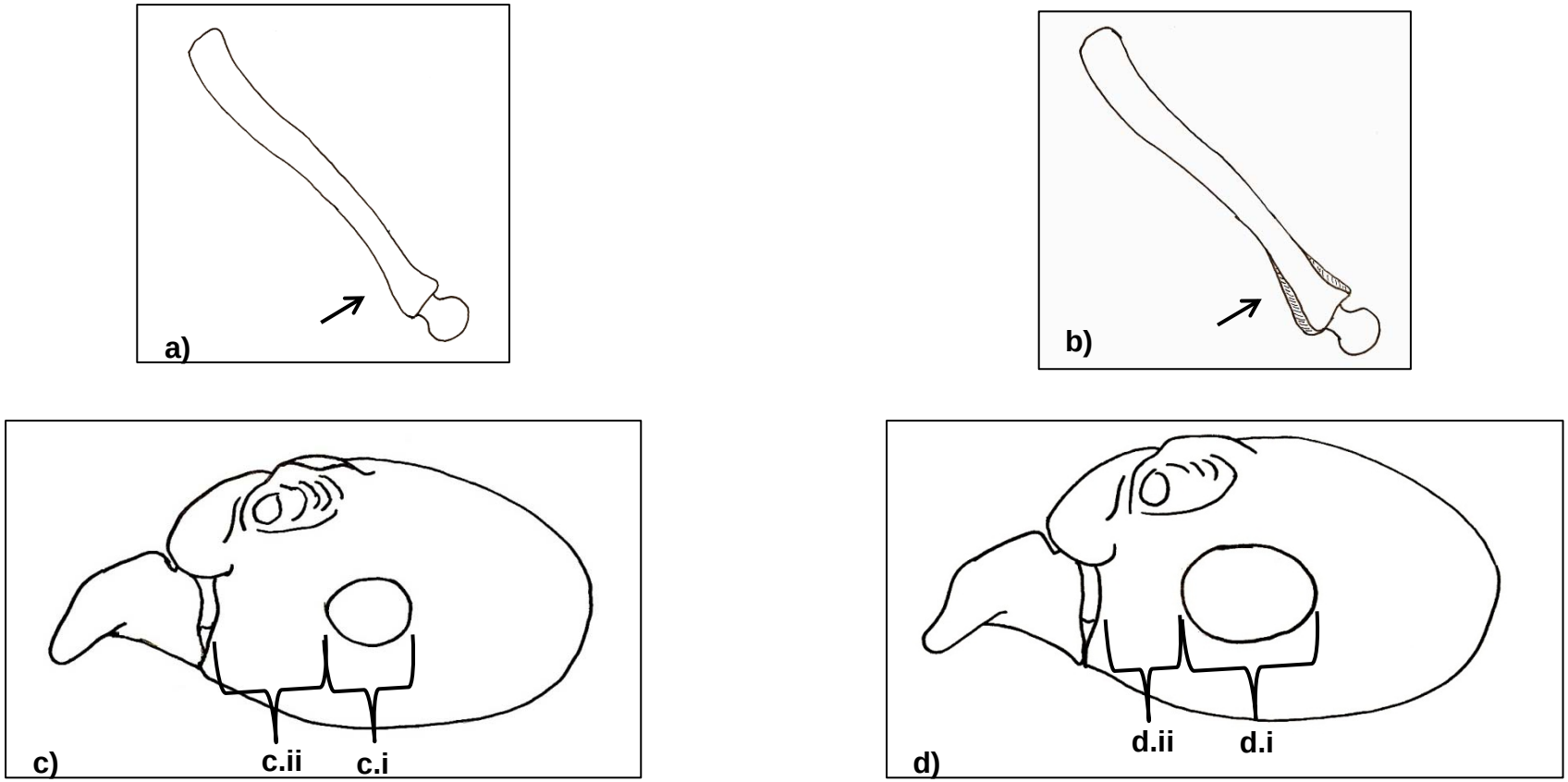
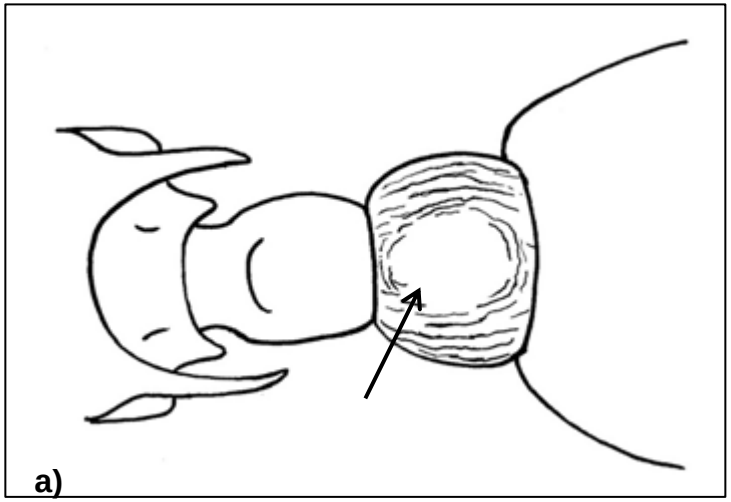


Figure 15.

12 (11)	Base of scape without lamina (a). Eye (c.i) shorter than gena (c.ii).	13
12’	Base of scape widens into dark laminal outgrowth (b). Eye (d.i) longer than gena (d.ii).	14



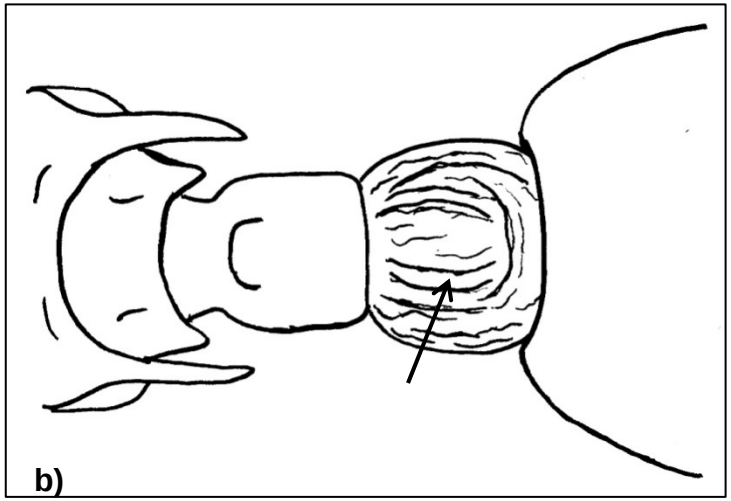


Figure 16.

13 (12)	Postpetiole with central dorsal area mostly lacking rugae (a), and relatively shiny.	*Myrmica alaskensis* Wheeler
13’	Entire postpetiole covered in rugae (b), and relatively dull.	*Myrmica incompleta* Provancher

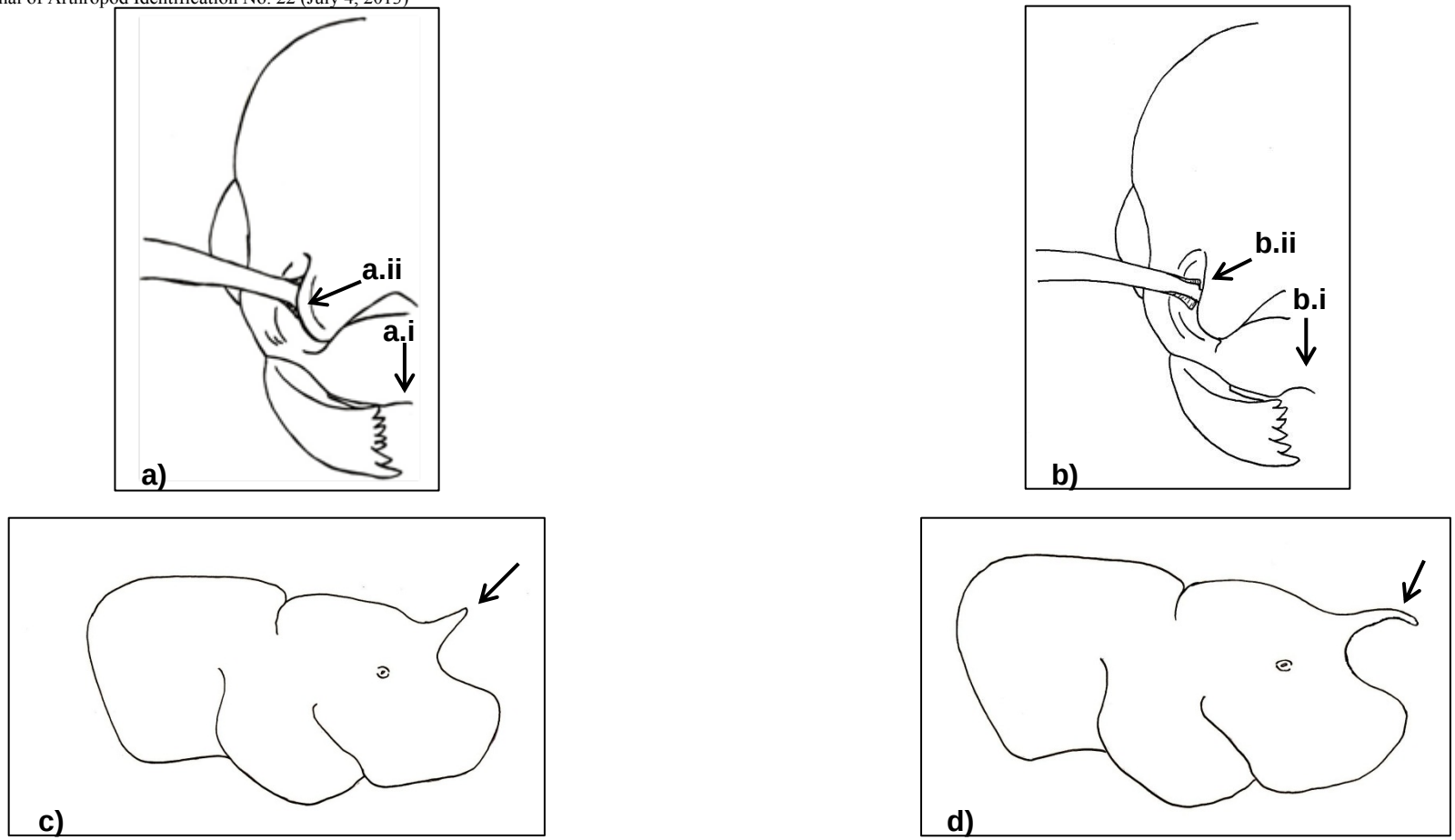


Figure 17.

14 (12)	In full face view, margin of clypeus shallowly concave (a.i); frontal lobes rounded (a.ii). Propodeal spines short and pointed upwards (c).	*Myrmica brevispinosa* Wheeler
14’	In In full face view, margin of clypeus deeply concave (b.i); posterior margin of frontal lobes straight (b.ii). Propodeal spines long and curved downwards (d).	*Myrmica lobifrons* Pergande

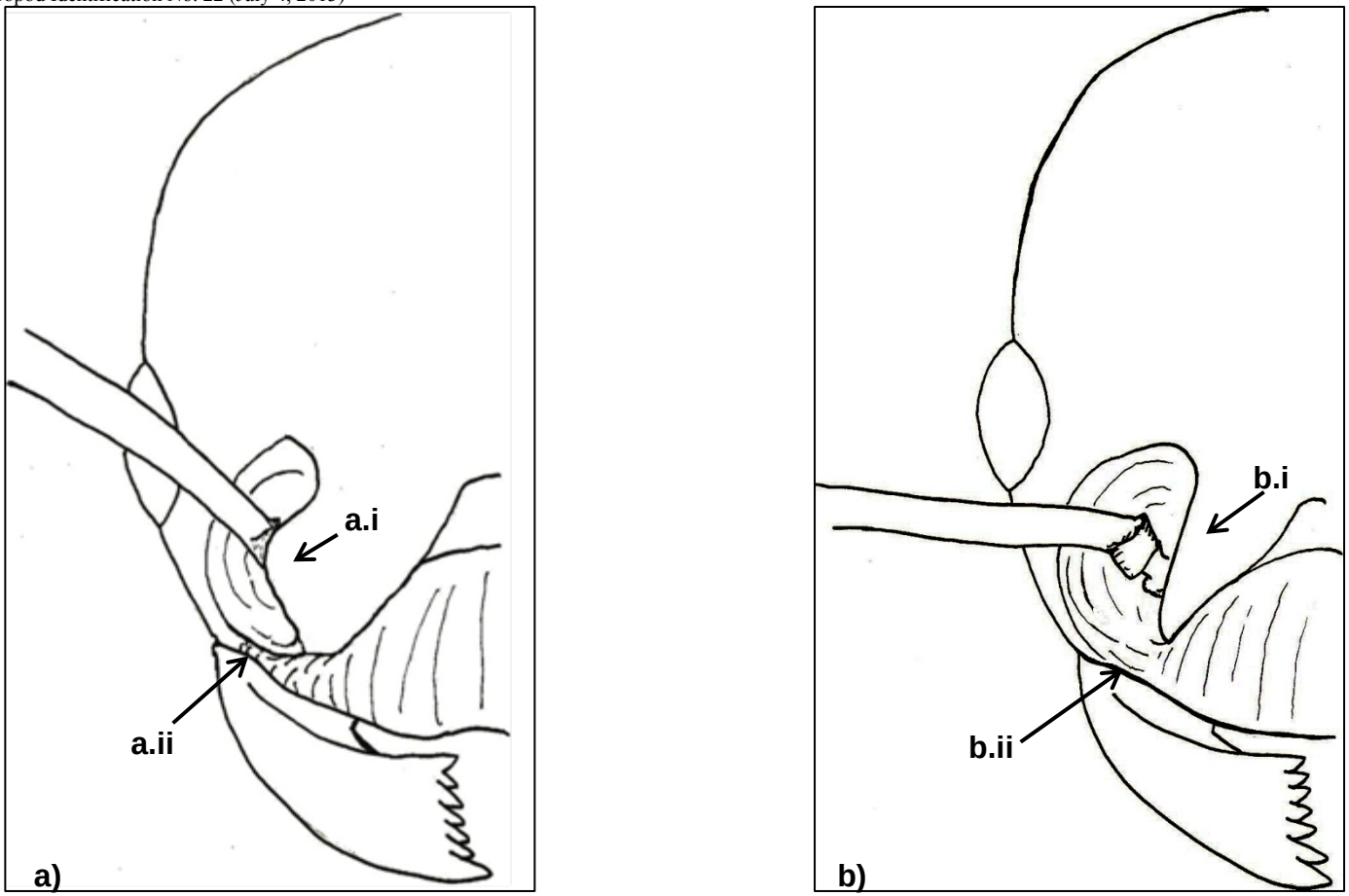


Figure 18.

15 (11)	In full face view, frontal lobes convex and extending over antennal fossae (a.i). Lateral wing of clypeus raised into a ridge closing the antennal fossa (a.ii) (not as prominent in some species, where it is a very thin ridge).	16
15’	In full face view, frontal lobes straighter and not extending as far over antennal fossae (b.i). Lateral wing of clypeus not forming ridge and not closing antennal fossa (b.ii).	20

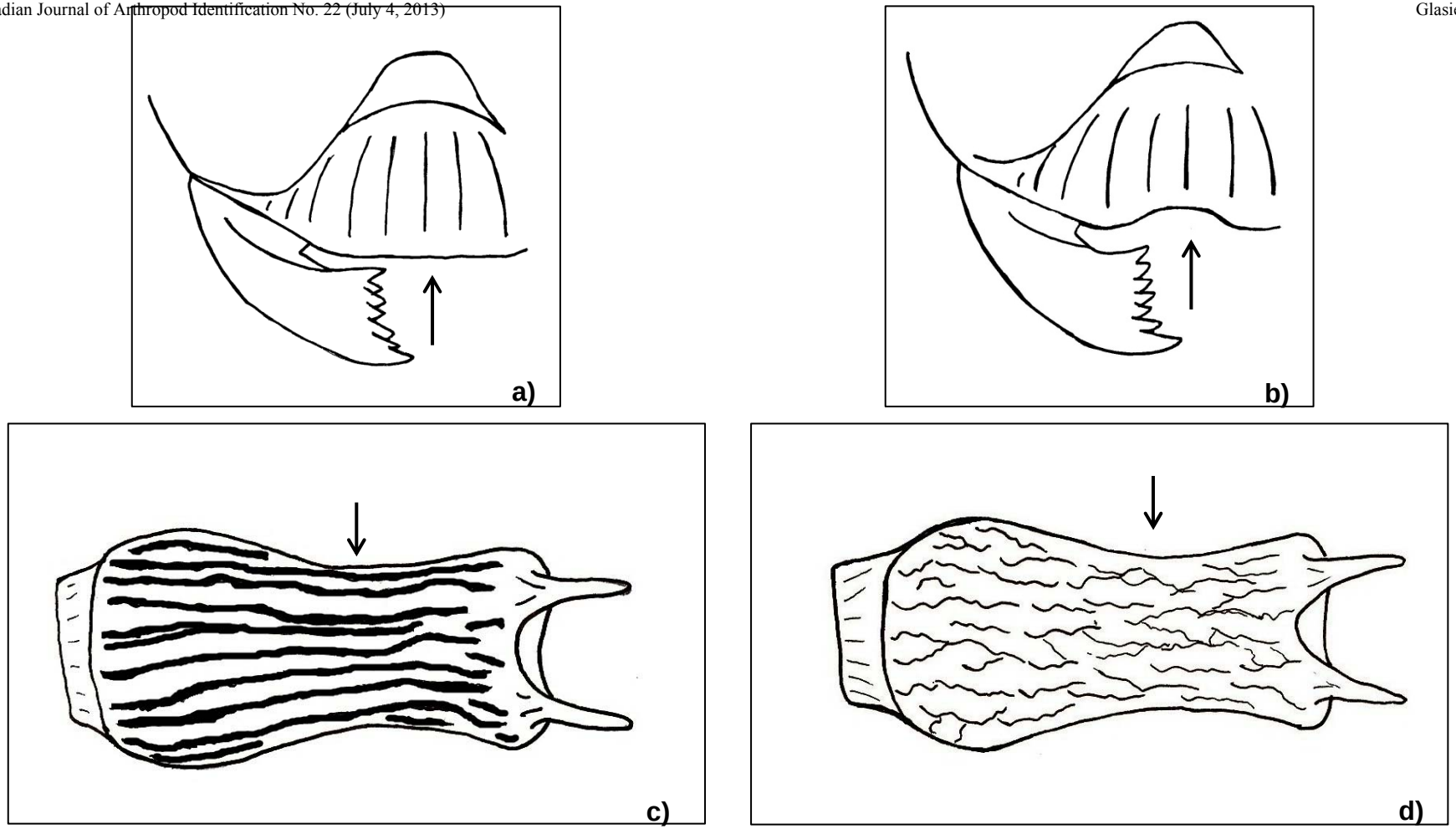


Figure 19.

16 (15)	In full face view, median margin of clypeus not concave (a). Striae on dorsal part of thorax deep and longitudinal (c).	17
16’	In full face view, median margin of clypeus concave (though sometimes weakly) (b). Striae on dorsal part of thorax more shallow, undulating and/or anastomosing (d).	18

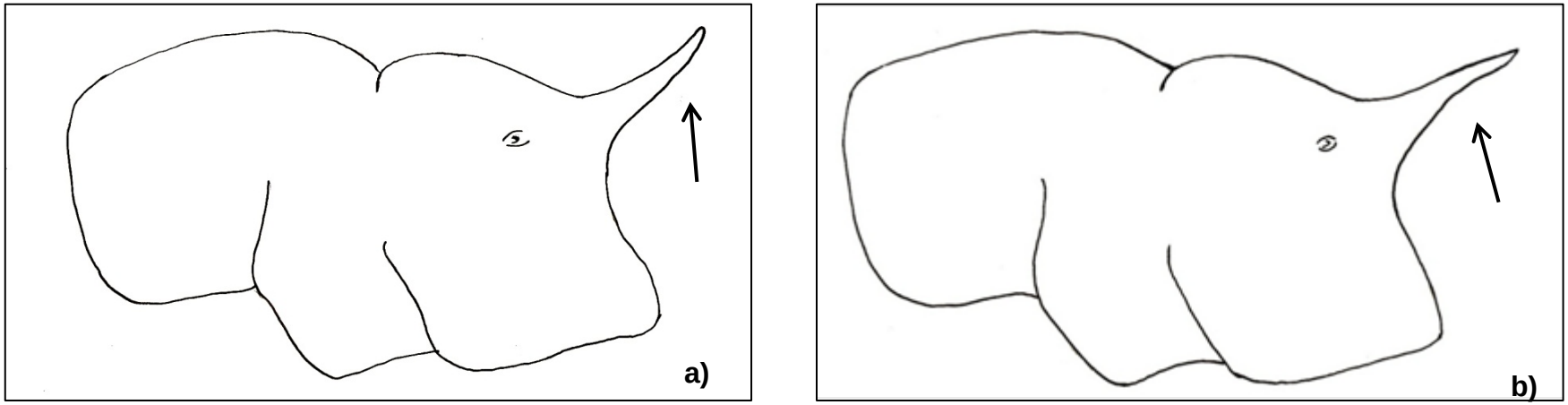


Figure 20.

17 (16)	Propodeal spines deflected upwards (a).	*Myrmica* ab01 (undescribed species)
17’	Propodeal spines straight or slightly deflected downwards (b).	*Myrmica crassirugis* Francoeur

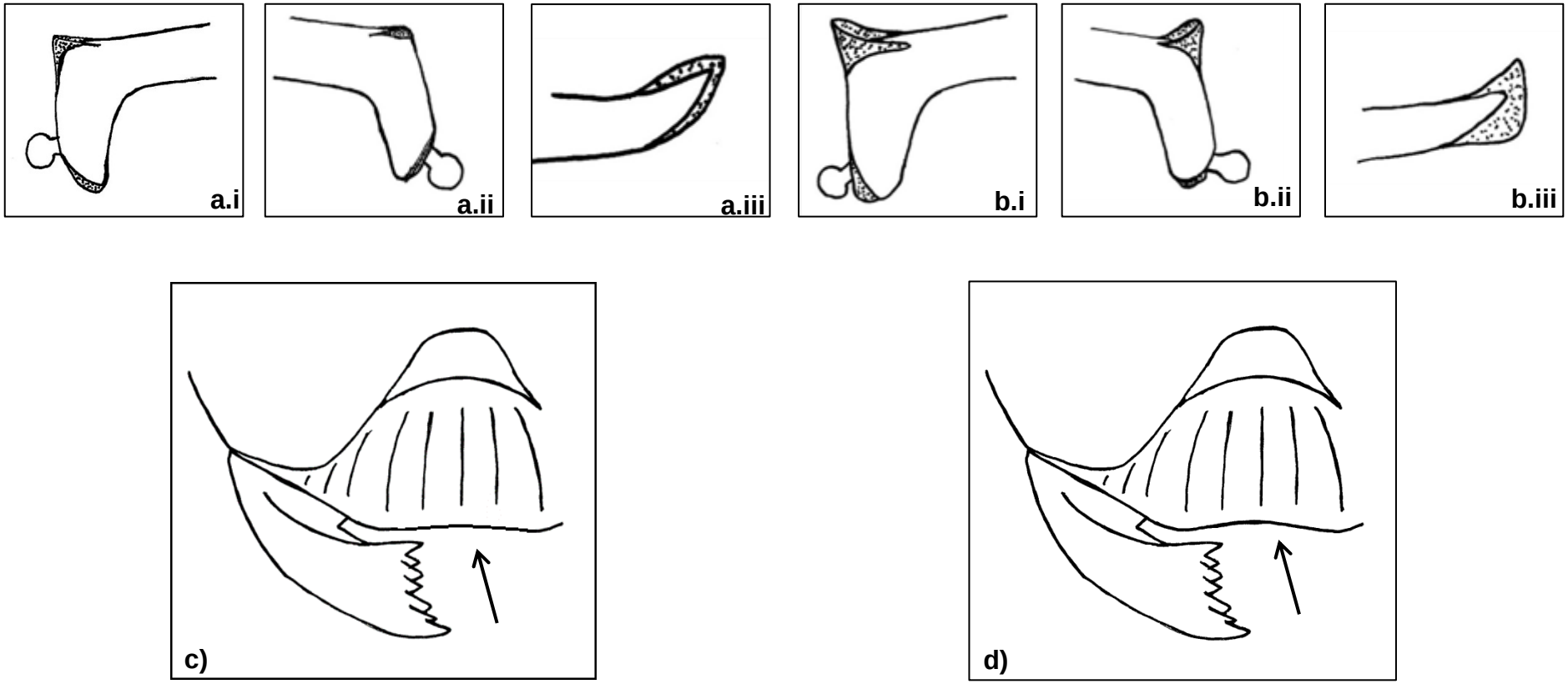


Figure 21.

18 (16)	Lamina on scape a darkened ridge, without a prominent projection (illustrations show right antenna at basal bend: a.i: posterior view; a.ii anterior view; a.iii dorsal view). In full face view, median margin of clypeus shallowly concave (c).	*Myrmica latifrons* Stärcke
18’	Lamina on scape with projection (illustrations show right antenna at basal bend: b.i: posterior view; b.ii anterior view; b.iii dorsal view). In full face view, median margin of clypeus distinctly concave (d).	19

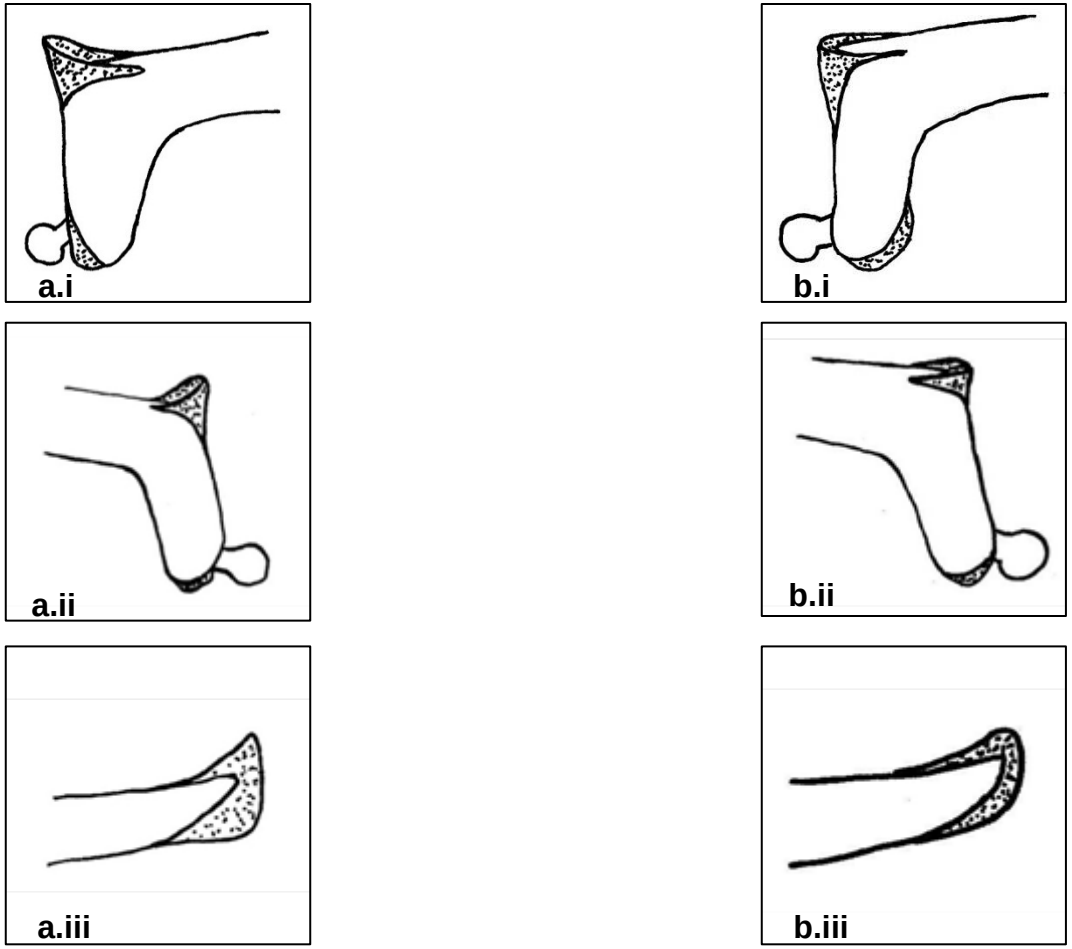


Figure 22.

19 (18)	Lamina on scape dish-like and projecting upwards (illustrations show right antenna at basal bend: a.i: posterior view; a.ii anterior view; a.iii dorsal view).	*Myrmica americana* Weber
19’	Lamina on scape a minor upward projection (illustrations show right antenna at basal bend: b.i: posterior view; b.ii anterior view; b.iii dorsal view).	*Myrmica* code AF-eva (undescribed species)

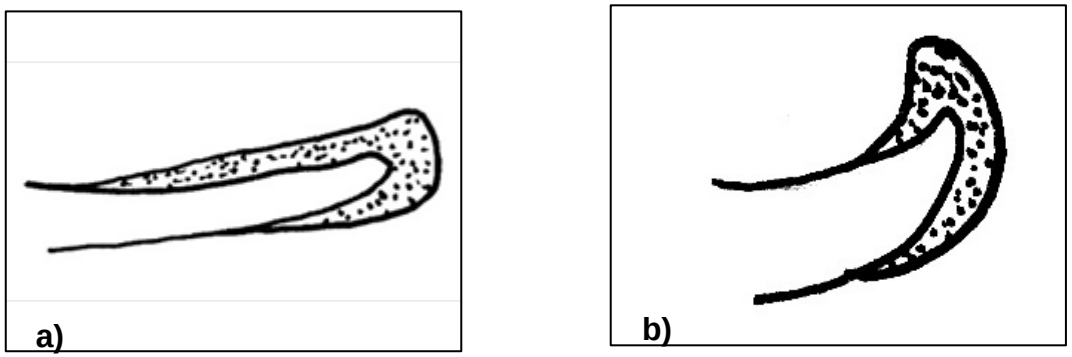


Figure 23.

20 (15)	In dorsal view antennal scape with a postero-lateral lamina that narrows as it extends away from basal bend (a). Illustrations show distal end of antenna to the left.	*Myrmica nearctica* Weber
20’	In dorsal view antennal scape with lamina restricted to basal bend (b). Illustrations show distal end of antenna to the left.	21

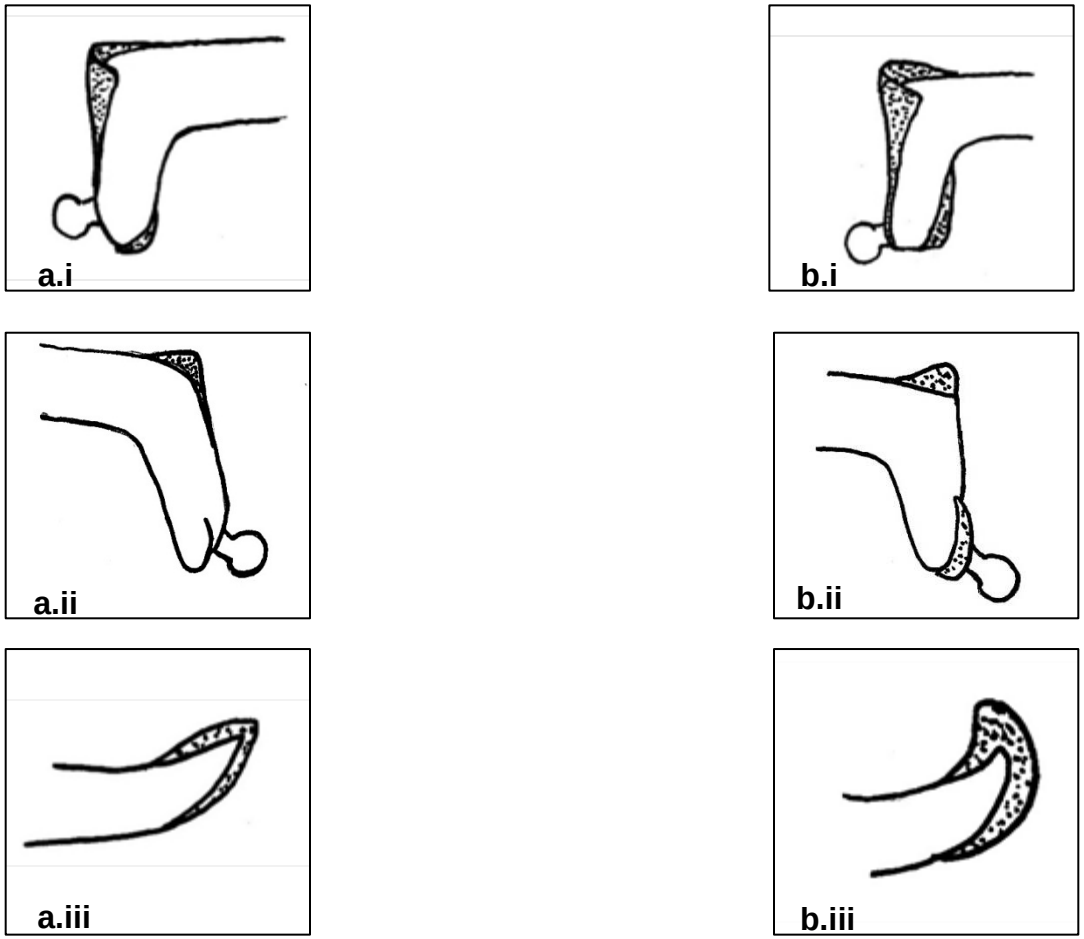


Figure 24.

21 (20)	Basal bend of antennal scape with lamina forming a small dorsal ridge (illustrations show right antenna at basal bend: a.i posterior view; a.ii anterior view; a.iii dorsal view).	*Myrmica fracticornis* Forel
21’	Basal bend of antennal scape with lamina forming a prominant flange (illustrations show right antenna at basal bend: b.i posterior view; b.ii anterior view; b.iii dorsal view).	*Myrmica detritinodis* Emery

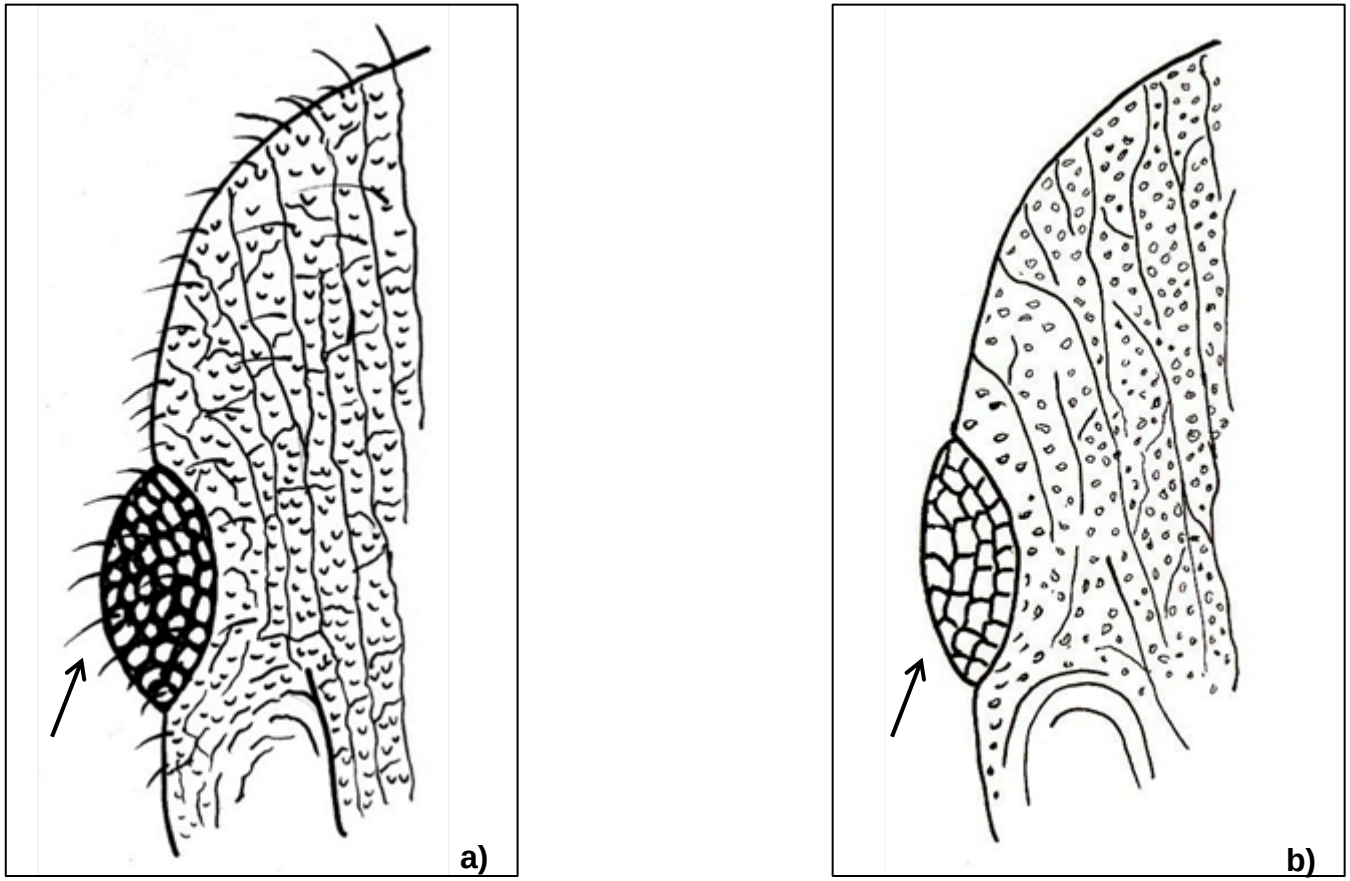


Figure 25.

22 (10)	Eyes with erect setae (a). (Genus *Formicoxenus*).	23
22’	Eyes without setae (b).	25

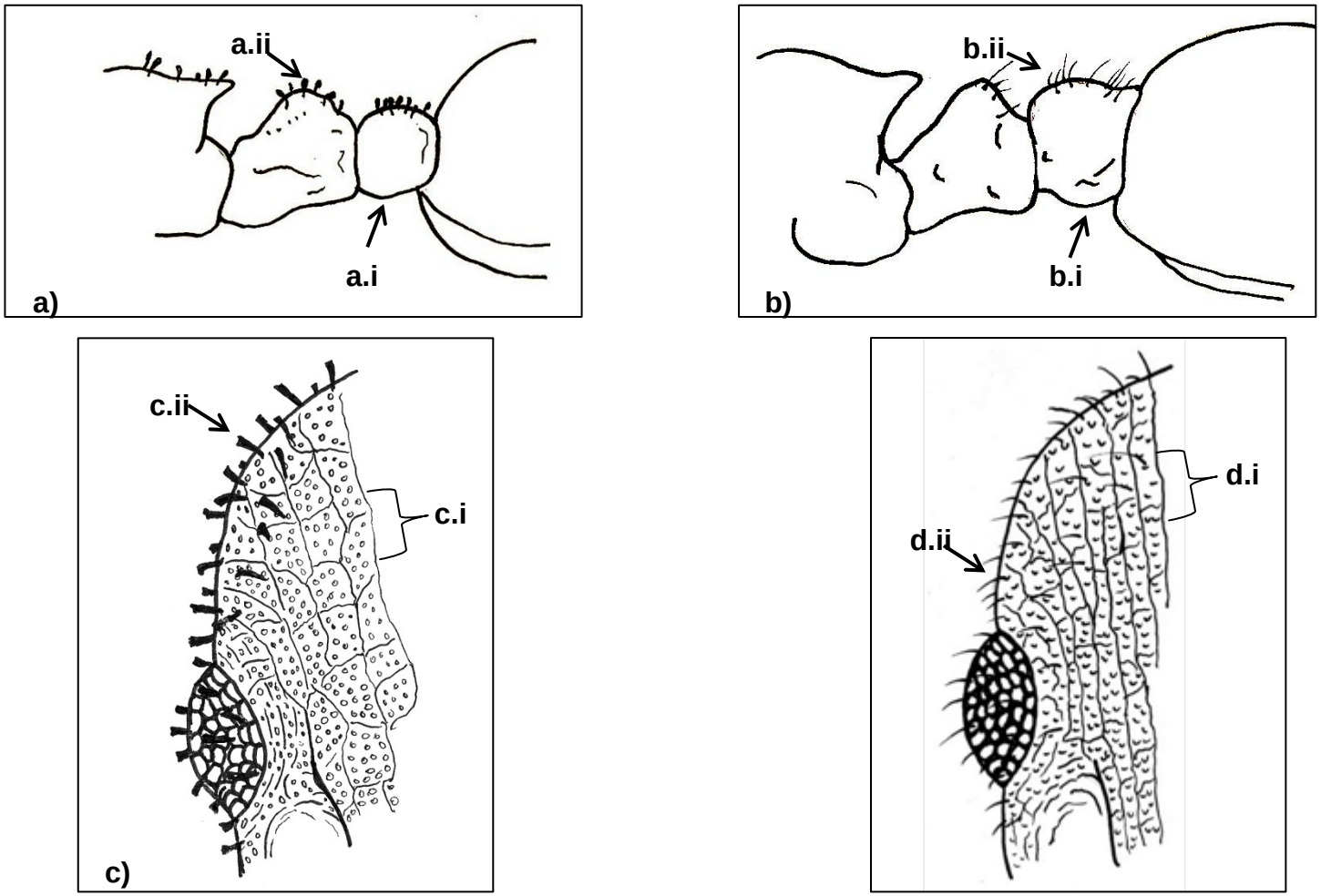
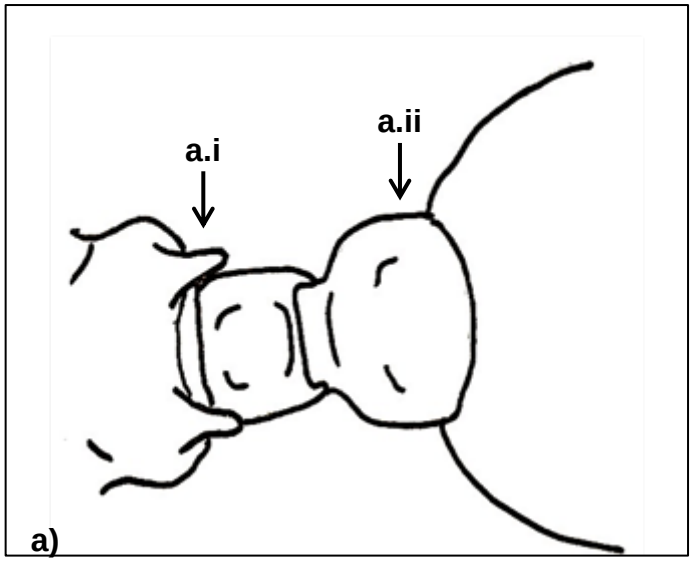


Figure 26.

23 (22)	Postpetiole obviously smaller than petiole and about one third the height of gaster (a.i). Head and thorax densely punctate, with fine reticulations (c.i). Setae on dorsal part of head (c.ii), thorax, and postpetiole (a.ii) claviform. Inquilines associated with *Formica rufa* species group.	*Formicoxenus hirticornis* (Emery)
23’	Postpetiole slightly smaller than petiole and about one half height of gaster (b.i). Head and thorax sparsely punctate with prominent, parallel reticulations (d.i). Setae on dorsal part of head (d.ii), thorax, and petiole (b.ii) fine and “hair-like”. Inquilines associated with *Myrmica* species.	24



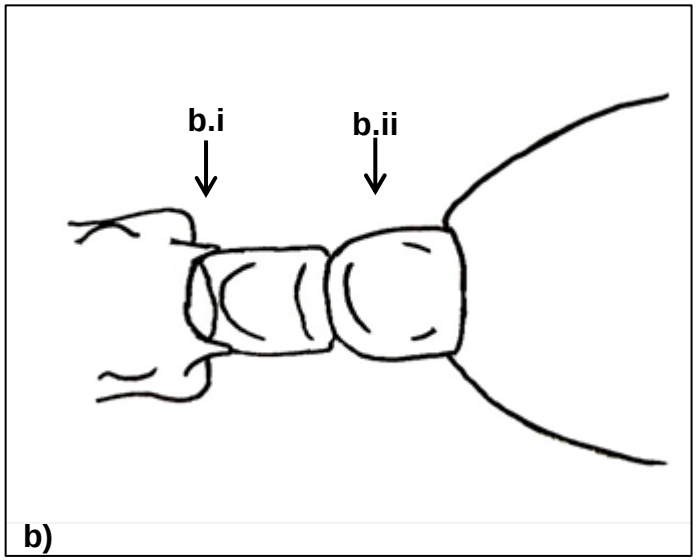


Figure 27.

24 (23)	Propedeal spines long (a.i) and postpetiole wider then long (a.ii). Inquilines associated with *Myrmica incompleta.*	*Formicoxenus provancheri* (Emery)
24’	Propedeal spines short (b.i) and postpetiole slightly longer (b.ii). Inquilines associated with *Myrmica alaskensis.*	*Formicoxenus quebecensis* Francoeur

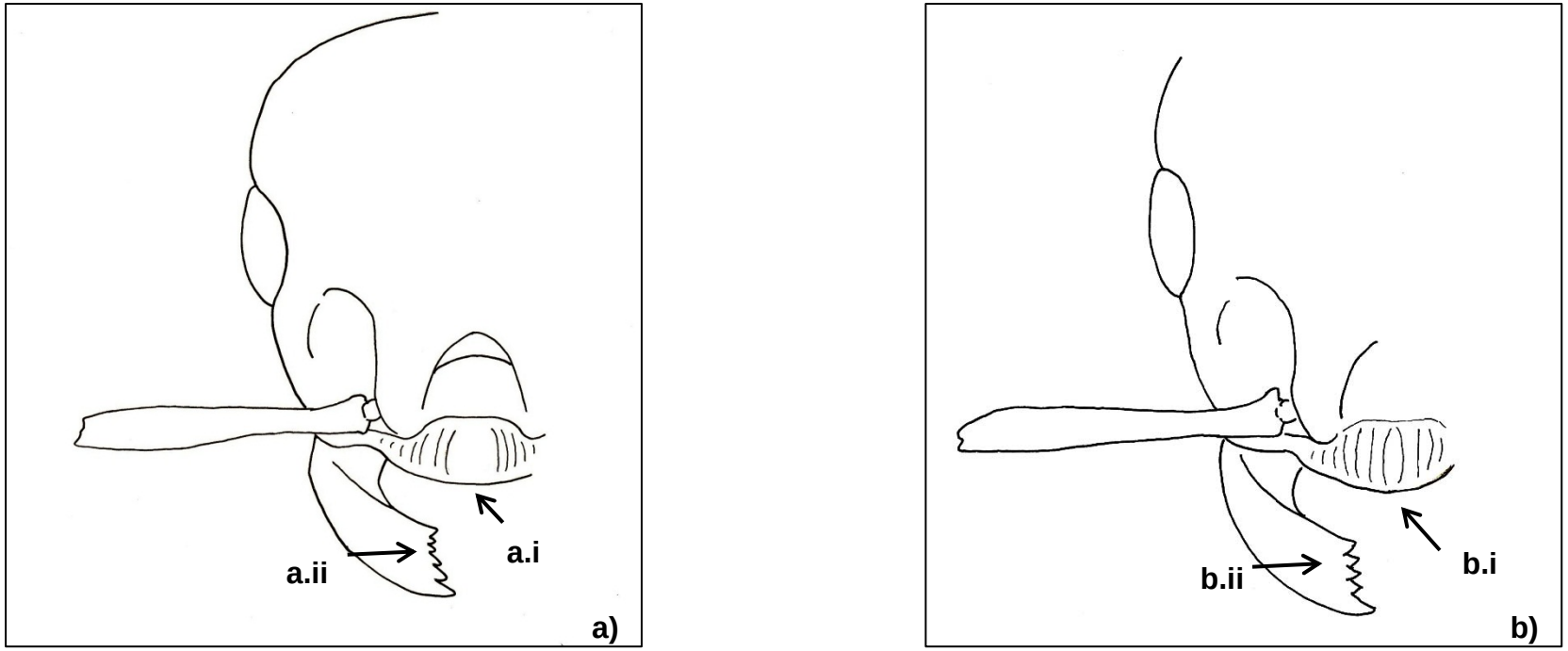
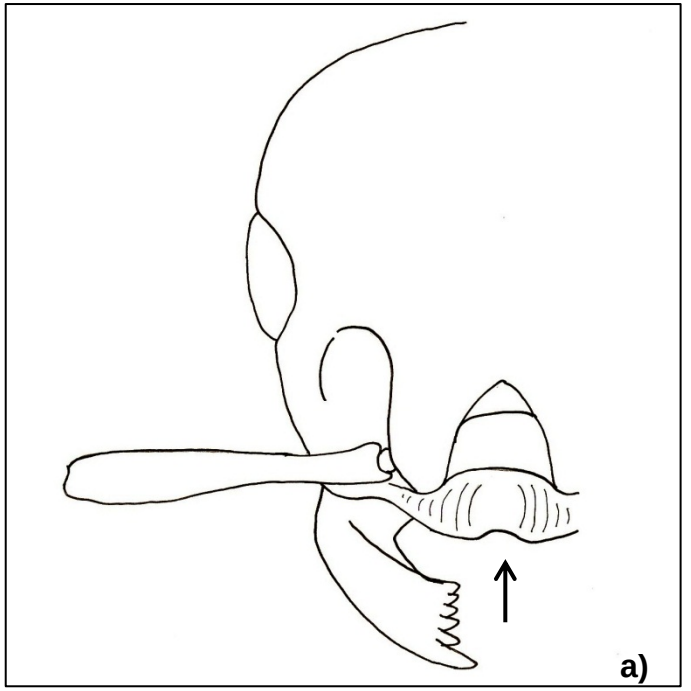


Figure 28.

25 (22)	Clypeus medially smooth and laterally carinate (a.i); mandible with six teeth (a.ii). (Genus *Leptothorax*).	26
25’	Clypeus wholly carinate (b.i); mandible with five teeth (b.ii). (Genus *Temnothorax*).	31



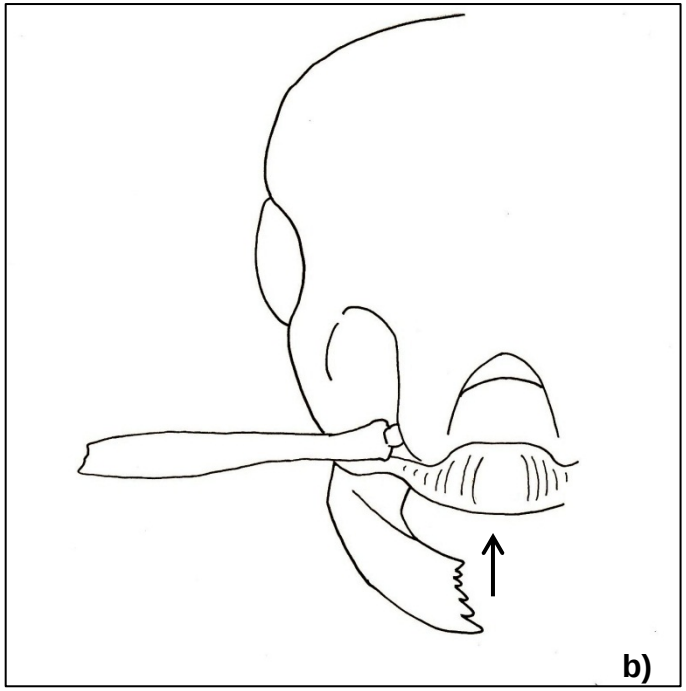
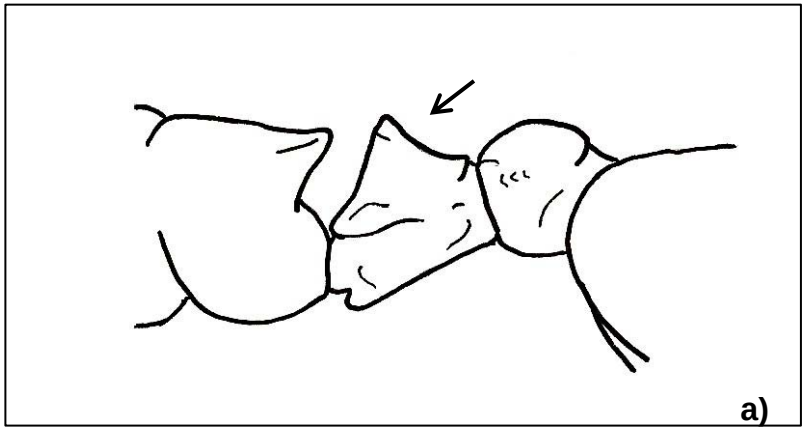


Figure 29.

26 (25)	In full face view, medial margin of the clypeus with a distinct notch (a).	*Leptothorax retractus* Francoeur
26’	In full face view, medial margin of clypeus without a distinct notch (b).	27



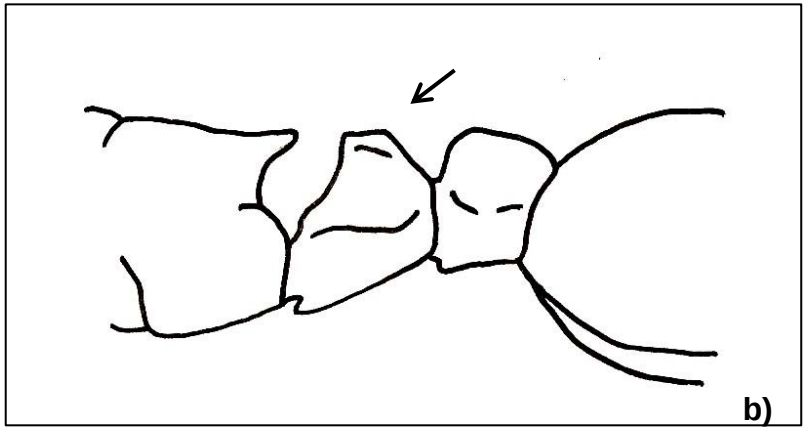


Figure 30.

27(26)	In profile, petiole distinctly triangular, with anterior and posterior faces about the same length, and dorsal surface pointed (a).	28
27’	In profile, petiole with anterior face longer than posterior face, and dorsal surface with either flattened, or rounded apex (b).	29

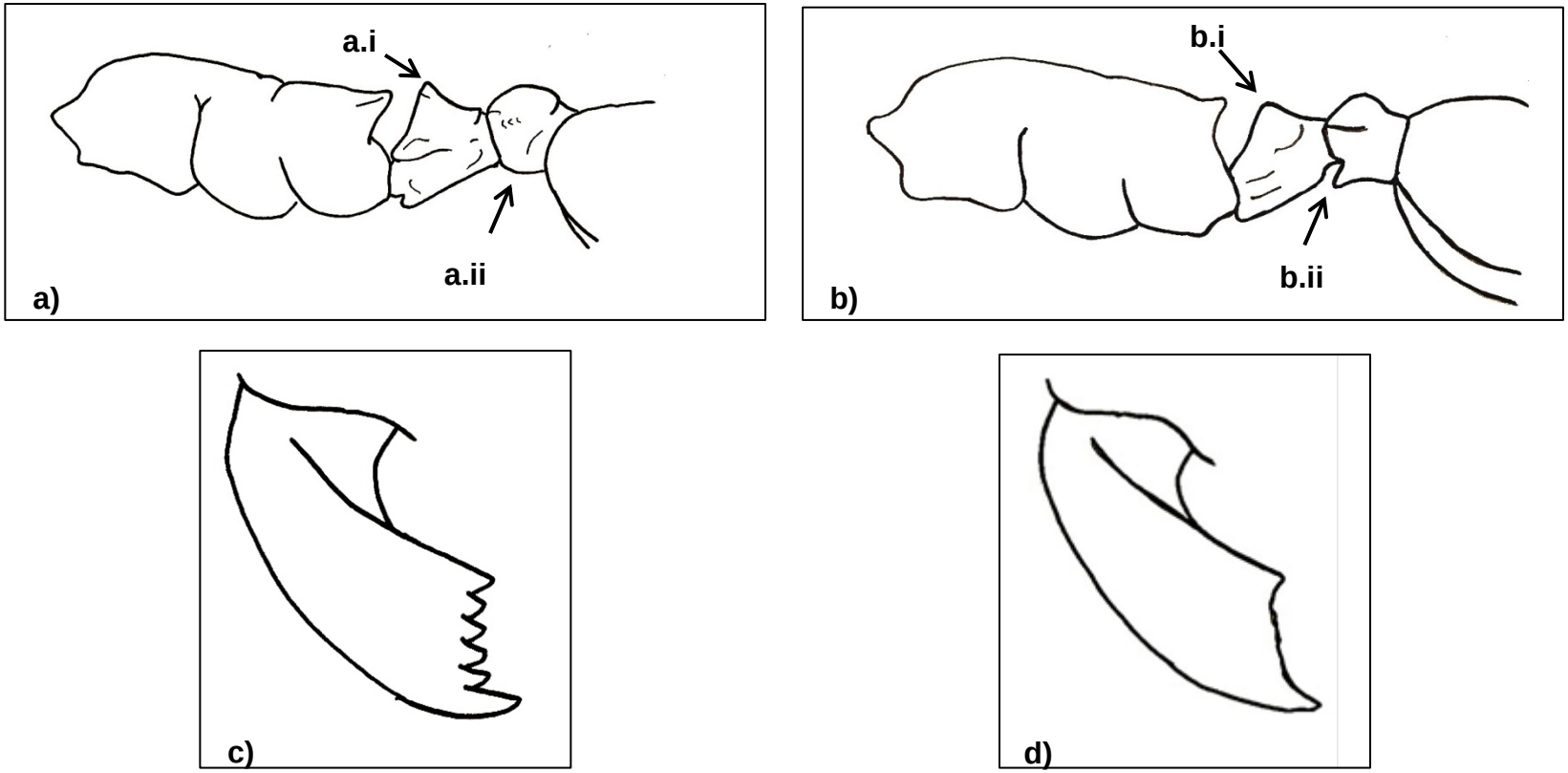


Figure 31.

28 (27)	In profile, apex of petiole distinctly sharp (a.i); postpetiole rounded lacking any distinct ventral anterior projection (a.ii). Teeth on mandible prominent (c). Non-inquilines with worker caste and queen. Diagnostic traits based on worker caste but also characterize queens.	*Leptothorax athabasca* Buschinger and Schulz
28’	In profile, apex of petiole rounded (b.i); postpetiole trapezoidal, but rounded dorsally, and with a distinct ventral anterior projection (b.ii). Mandible lacking teeth (d). Inquilines associated with *Leptothorax muscorum.* Worker caste is absent; diagnostic traits based on queens.	*Leptothorax wilsoni* Heinze

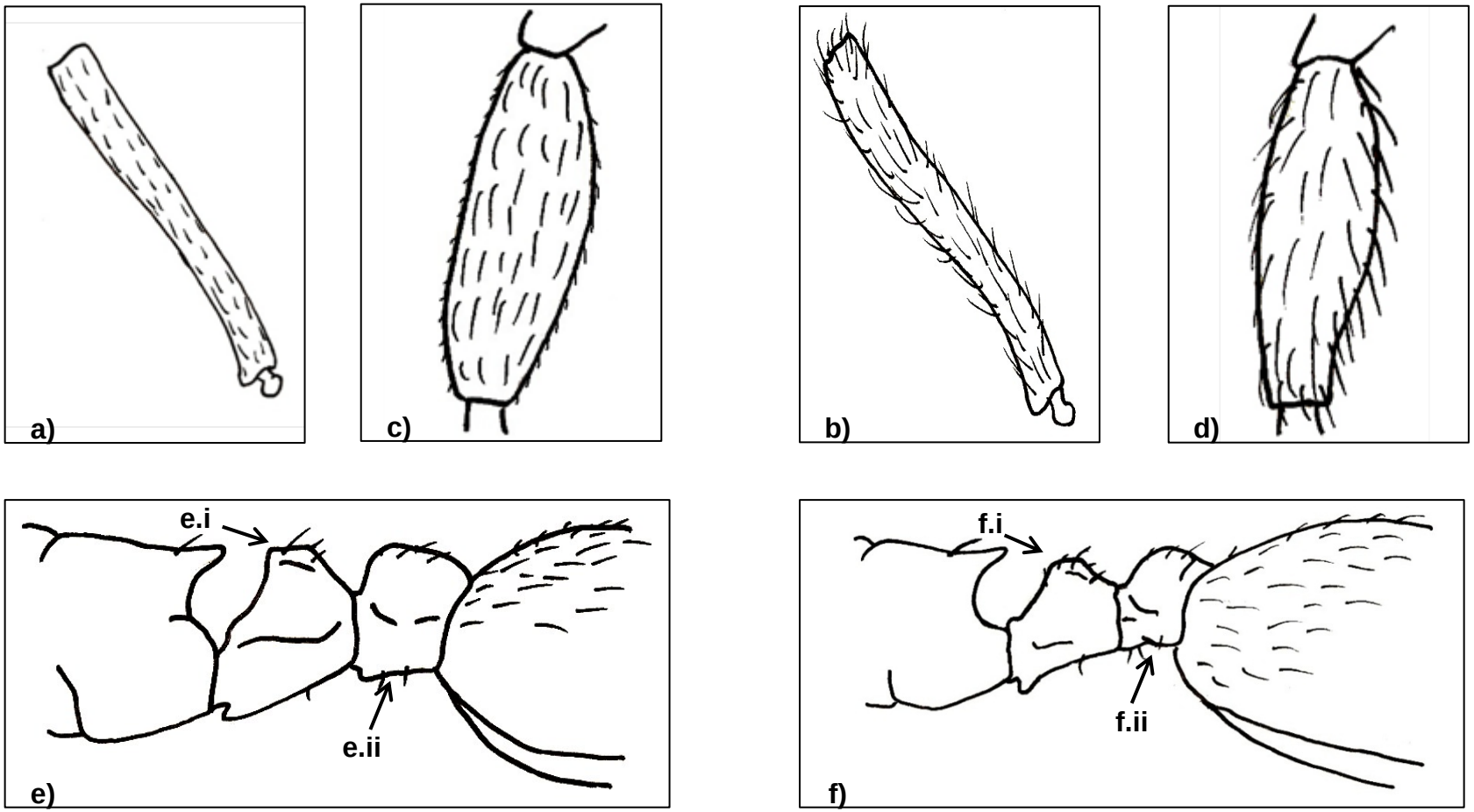
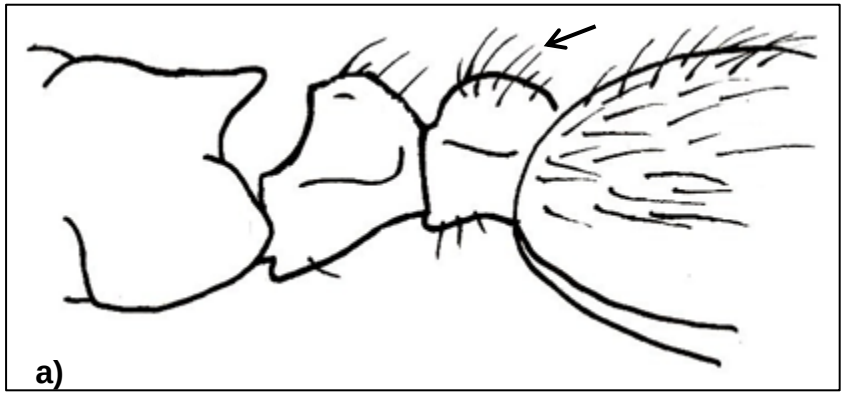


Figure 32.

29 (27)	Erect setae absent on scape (a) and tibia (c). In profile, dorsal surface of petiole flat (e.i); postpetiole rectangular and taller than long (e.ii). Inquilines associated with *Leptothorax muscorum.*	*Leptothorax faberi* Buschinger
29’	Erect setae present on scape (b) and tibia (d). In profile dorsal surface of petiole slightly rounded (f); postpetiole rounded and about as tall as long. Non-inquilline.	30



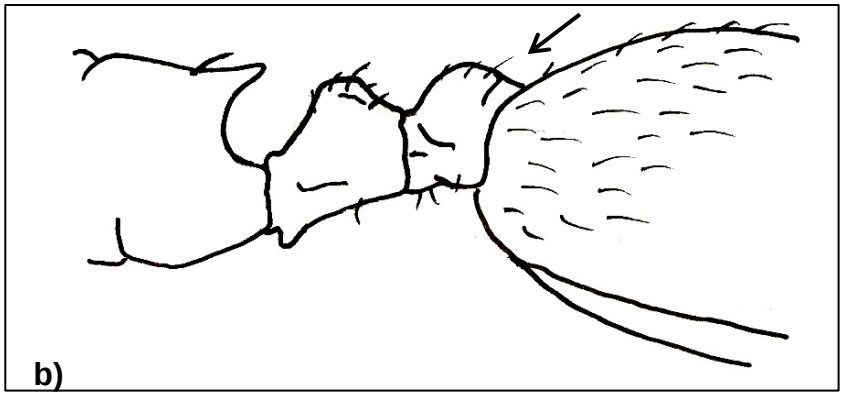
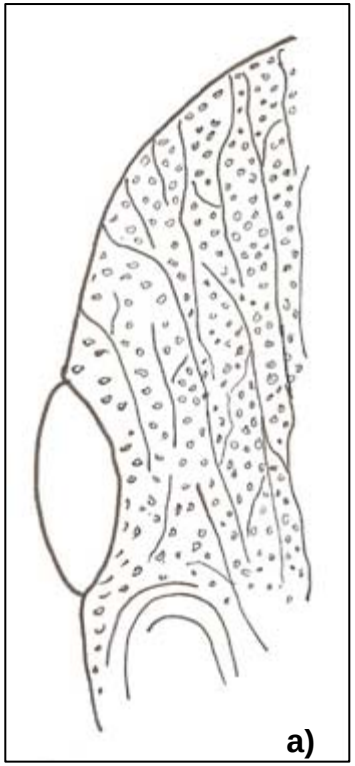


Figure 33.

30 (29)	Setae on petiole, postpetiole and gaster long (0.06 - 0.1mm) (a). See taxonomic issues section for more details.	*Leptothorax pocahontas* (Buschinger)
30’	Setae on petiole, postpetiole and gaster short (0.04 - 0.06mm) (b). See taxonomic issues section for more details.	*Leptothorax muscorum* (Nylander)



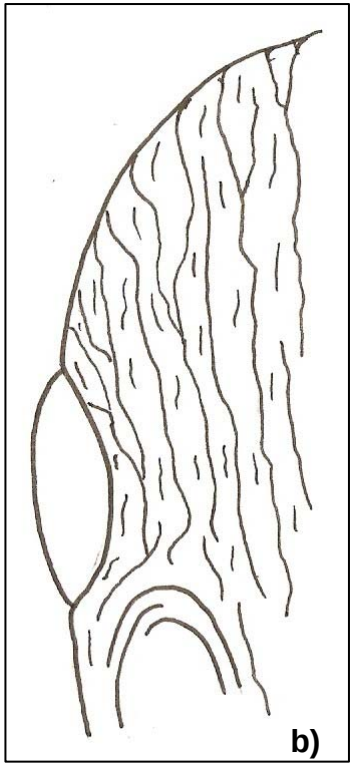


Figure 34.

31 (25)	Head punctate, and with delicate longitudinal rugae (a).	*Temnothorax ambiguus* (Emery)
31’	Head weakly or not punctate, and with coarse longitudinal rugae (b).	32

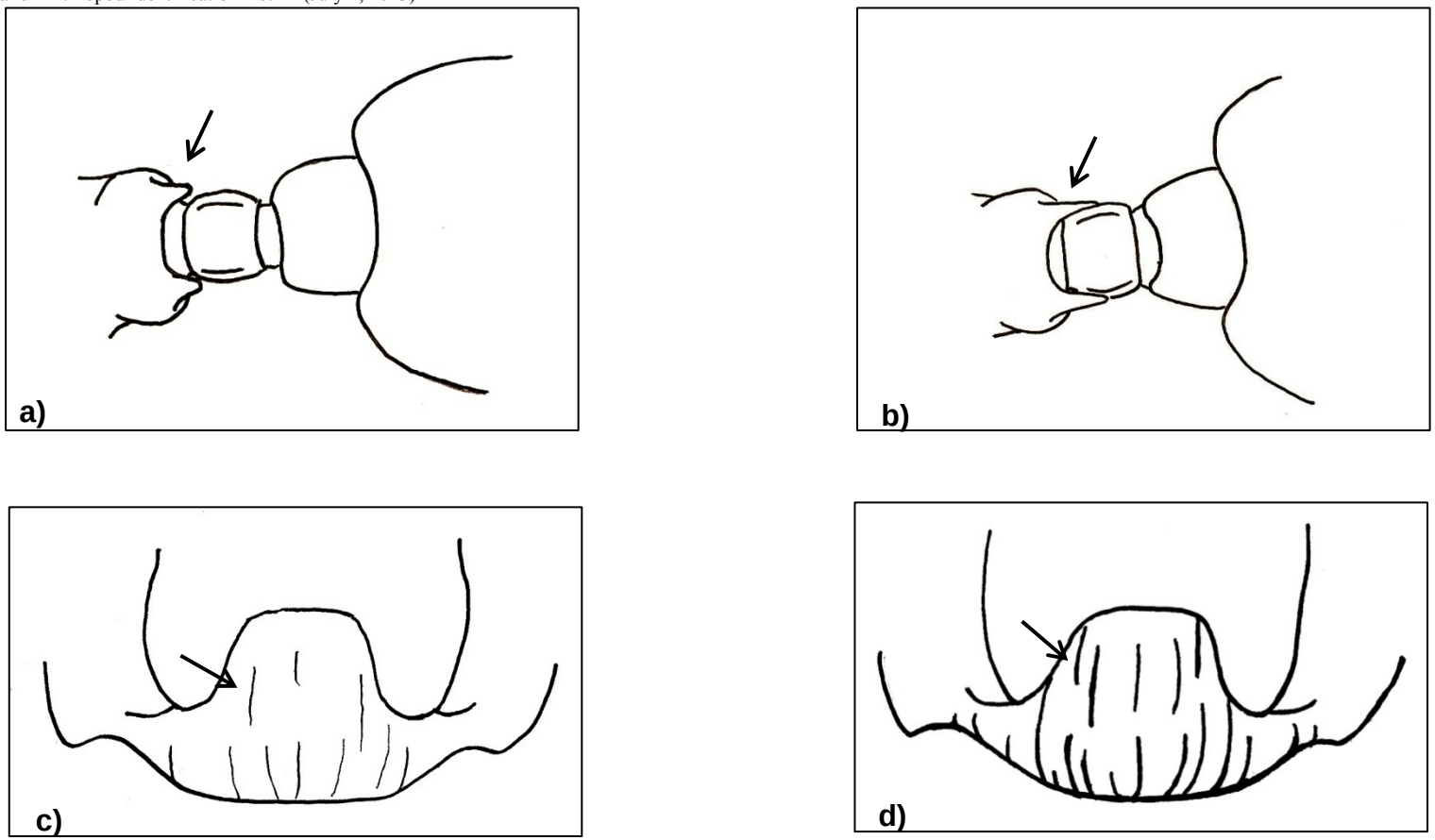
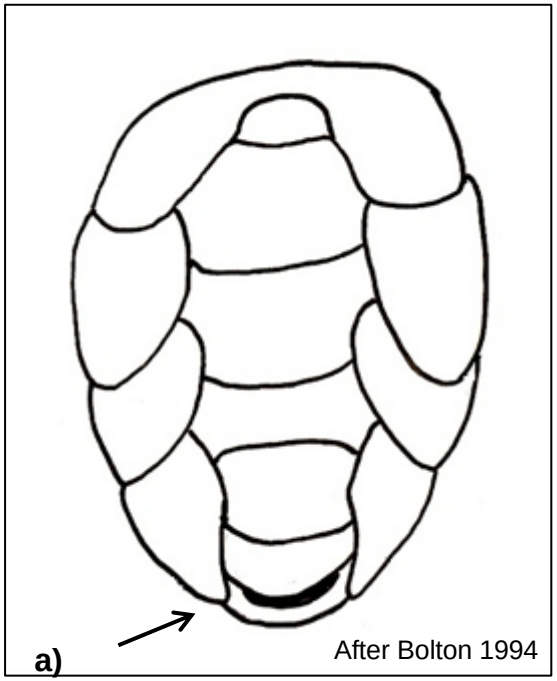


Figure 35.

32 (31)	Propedeal spines thick, with blunt apices (a). Clypeus covered with fine rugae (c).	*Temnothorax fragosus* (Mackay and Buschinger)
32’	Propedeal spines slender with sharp apices (b). Clypeus covered with coarse rugae (d).	*Temnothorax rugatulus* (Emery)



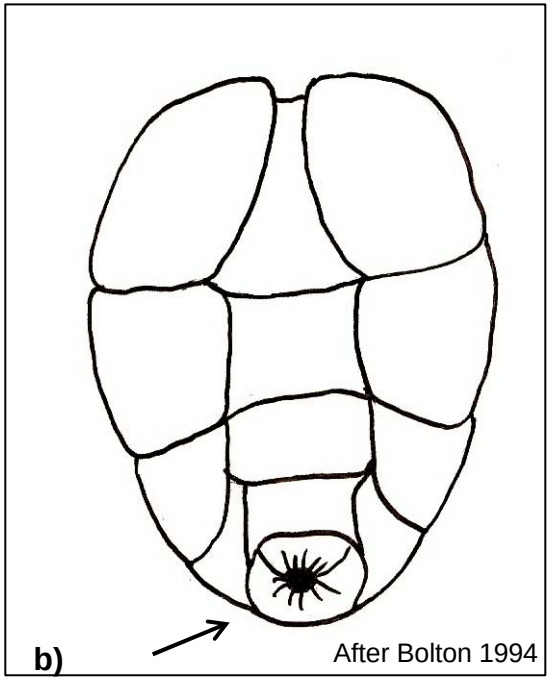
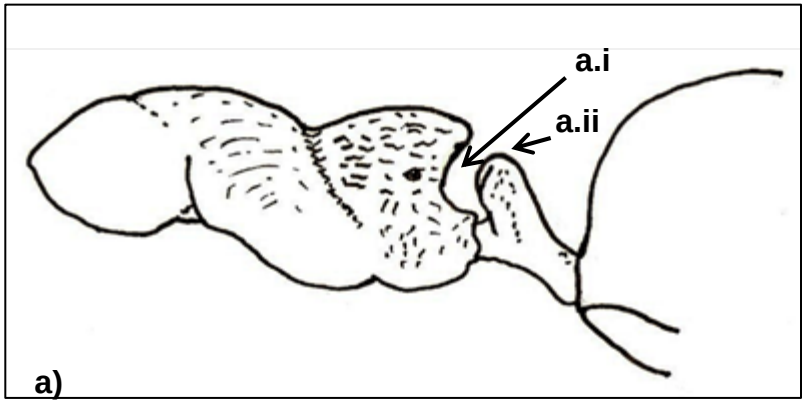


Figure 36.

33 (1)	Apical opening of gaster transverse, and not surrounded by a fringe of setae (a). (Subfamily Dolichoderinae).	34
33’	Apical opening of gaster circular and typically surrounded by a fringe of setae (b). If fringe of setae not present, antennal insertions set well away from the clypeus (see genus *Camponotus* : 37). (Subfamily Formicinae).	36



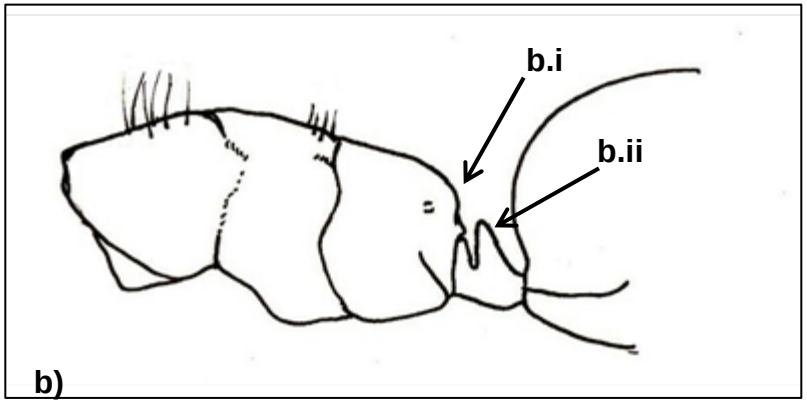


Figure 37.

34 (33)	Posterior face of propodeum strongly concave in profile, overhanging petiole (a.i). Petiolar scale obvious, sub-erect and fitting into shelf (a.ii). Propodeum distinctly sculptured (a). Colour uniform brownish-black to piceous black, very shiny.	*Dolichoderus taschenbergi* (Mayr)
34’	Posterior face of propodeum not overhanging petiole (b.i). Petiolar scale small to vestigial (b.ii). Propodeum lacking sculpture (b). Colour variable, dull.	35

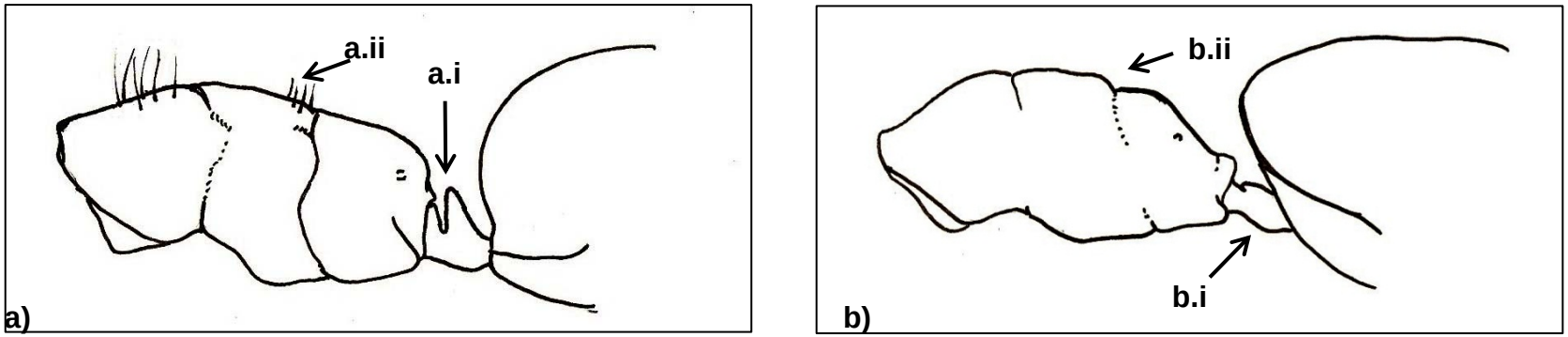
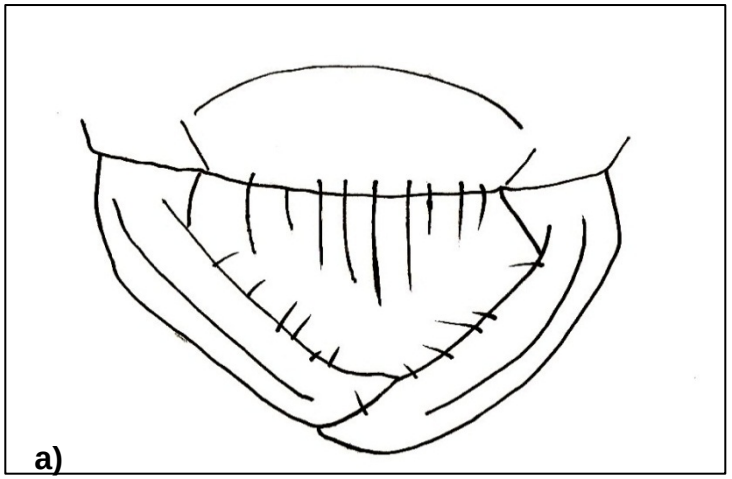


Figure 38.

35 (34)	Petiole scale protruding upwards (a.i). Erect setae on dorsum of thorax (a.ii).	Genus *Liometopum* (not yet known from Alberta, but expected in southwestern areas)
35’	Petiole flattened, not protruding upwards (b.i); often concealed by gaster. No erect setae on dorsum of thorax (b.ii).	*Tapinoma sessile* (Say)



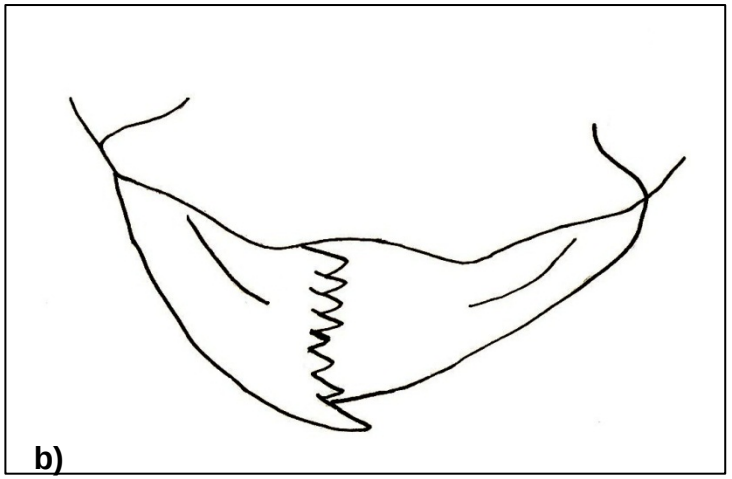


Figure 39.

36 (33)	Mandible sickle-shaped, without teeth (a). (Genus *Polyergus*)	*Polyergus breviceps* (Emery)
36’	Mandible angular, with teeth (b).	37

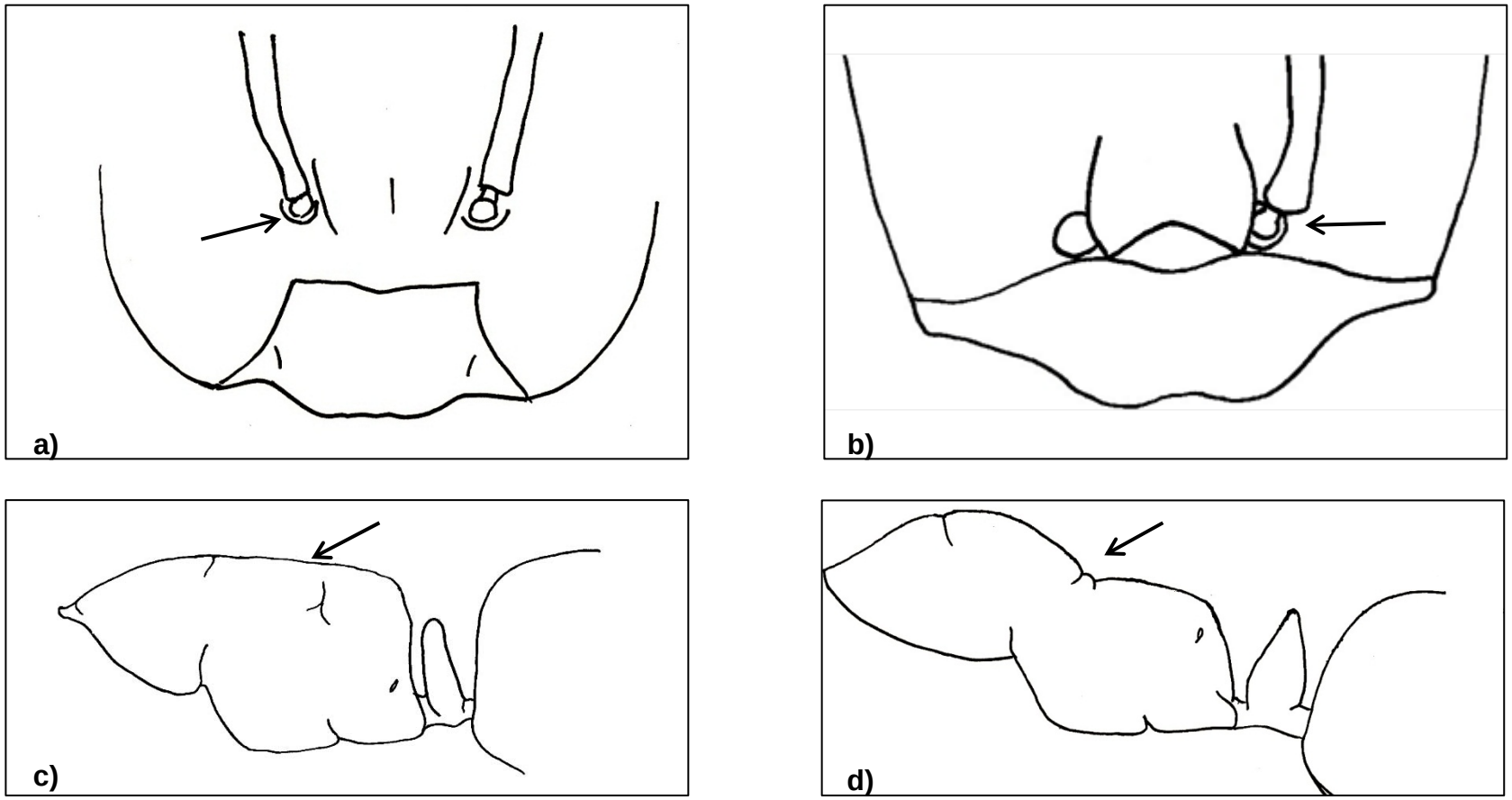


Figure 40.

37 (36)	Antennal sockets situated well behind posterior margin of clypeus (a). Mesosomal profile evenly convex (c). (Genus *Camponotus*. Note: major workers are identifiable with this key; minor workers may or may not be, so it is valuable to collect series from colonies for comparison).	38
37’	Antennal sockets even with posterior margin of the clypeus (b). Mesosomal profile interrupted at metanotal groove, with the propodeum below the level of mesonotum (d).	43

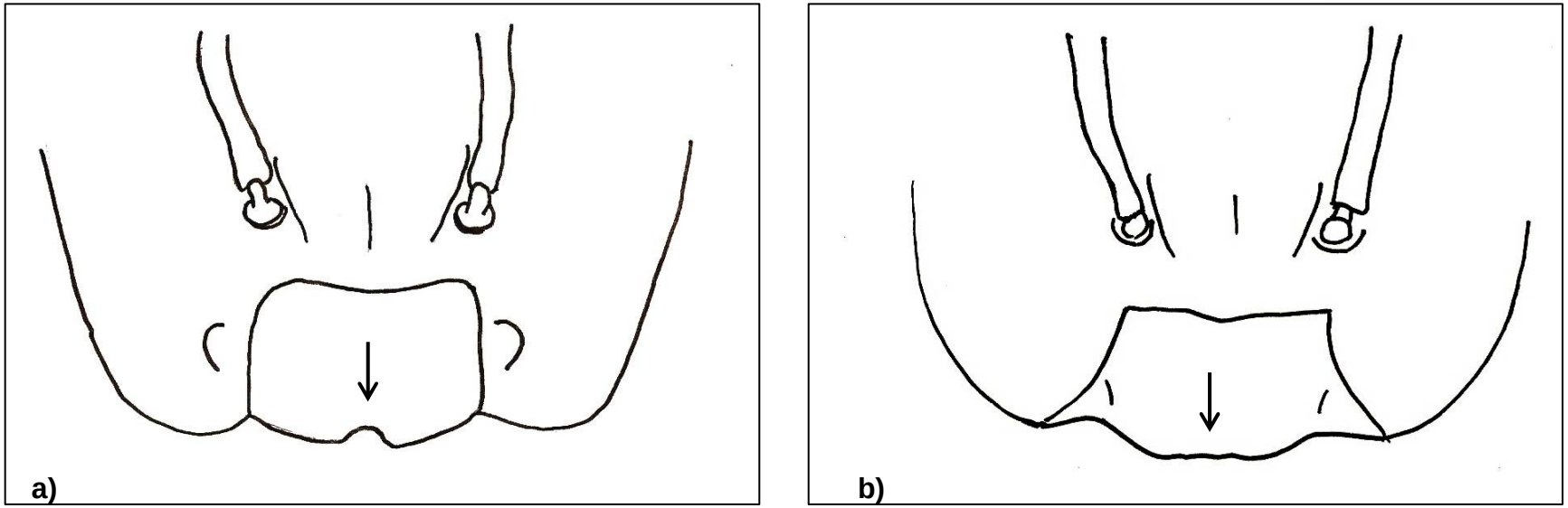
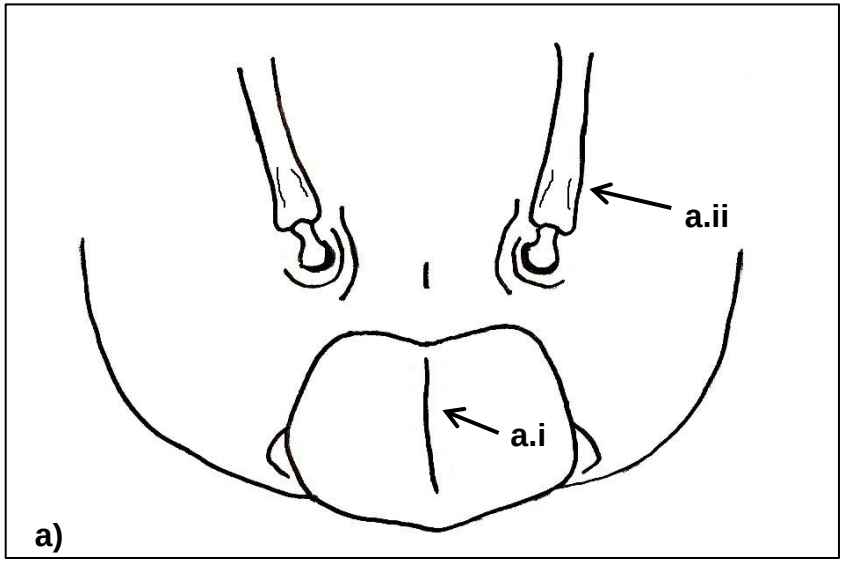


Figure 41.

38 (37)	Anterior border of clypeus notched (a). (Subgenus *Myrmetoma*).	*Camponotus nearcticus* Emery
38’	Anterior border of clypeus not notched (b).	39



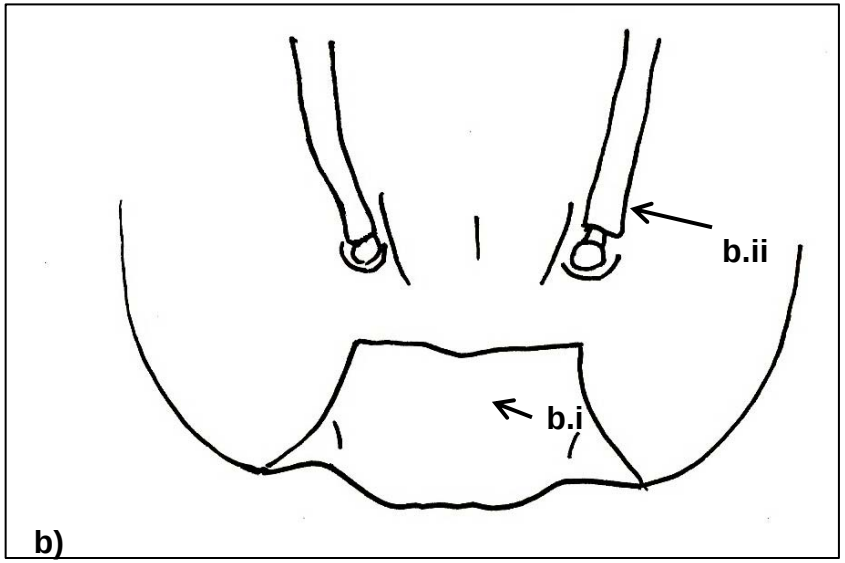


Figure 42.

39 (38)	Clypeus with distinct medial ridge (a.i). Base of scape relatively flattened (a.ii) (examine at a variety of angles to confirm). Head of major usually as long or longer than wide (more rectangular). (Subgenus *Tanaemyrmex*).	*Camponotus vicinus* Mayr
39’	Clypeus with less distinct medial ridge (b.i). Base of scape less flattened (b.ii) (examine at a variety of angles to confirm). Head of major usually wider than long (more square). (Subgenus *Camponotus*).	40

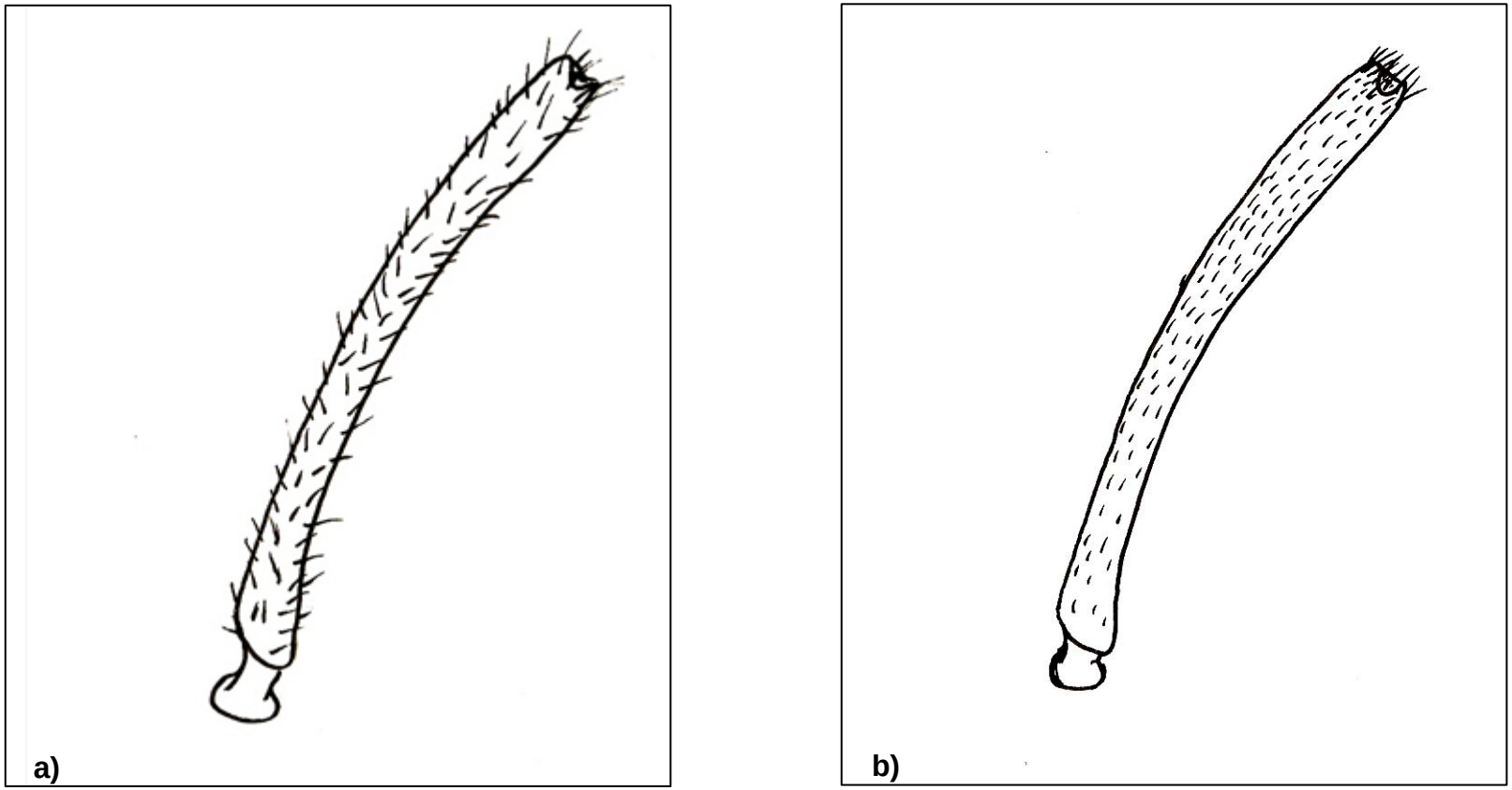
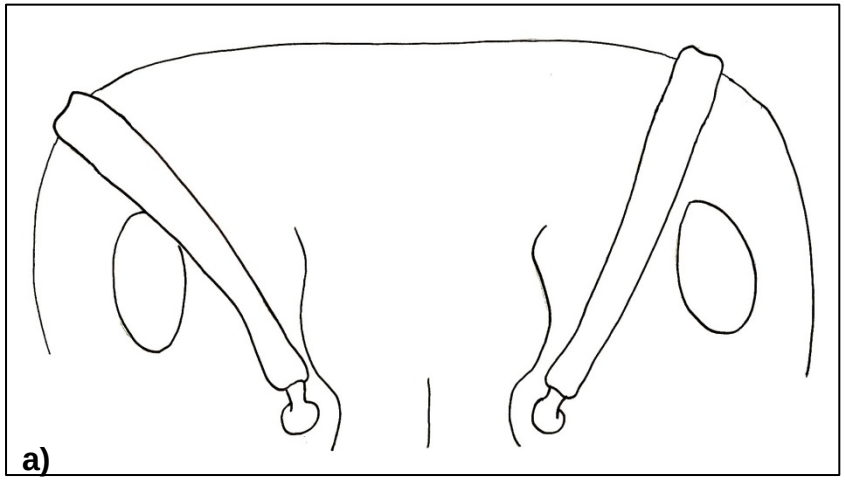


Figure 43.

40 (39)	Scape with short erect setae (a). Body entirely concolourous jet black and shiny.	*Camponotus laevigatus* (Smith)
40’	Scape with appressed or no setae; erect setae may be present on extreme tip of scape (b). Body bicoloured.	41



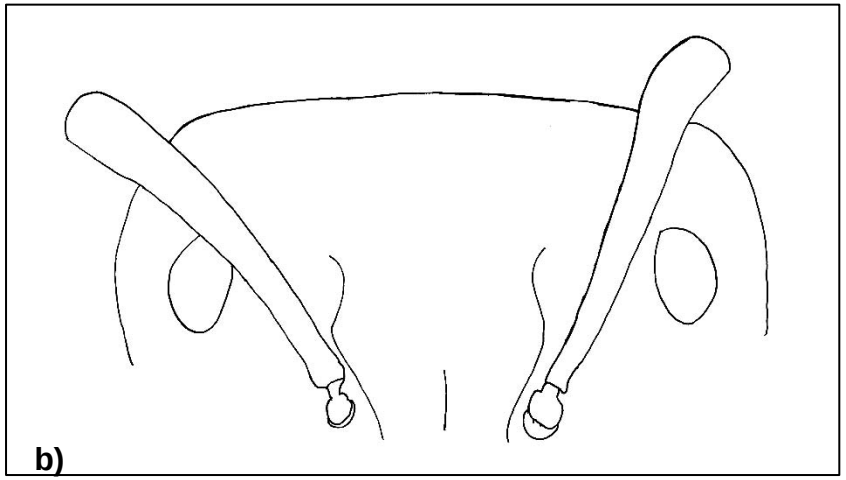
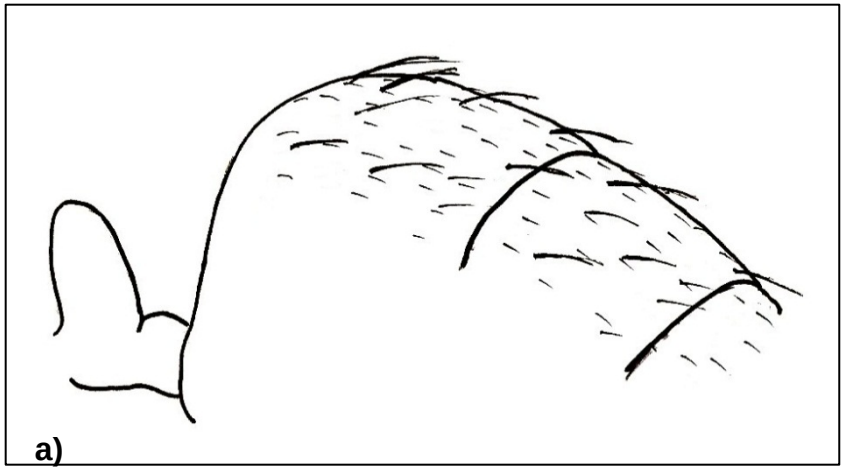


Figure 44.

41 (40)	Scape of majors barely reaches posterior corner of head in full face view, (sometimes not surpassing the posterior margin) (a).	*Camponotus herculeanus* (Linnaeus)
41’	Scape of majors prominently surpasses posterior corner of head in full face view (b).	42



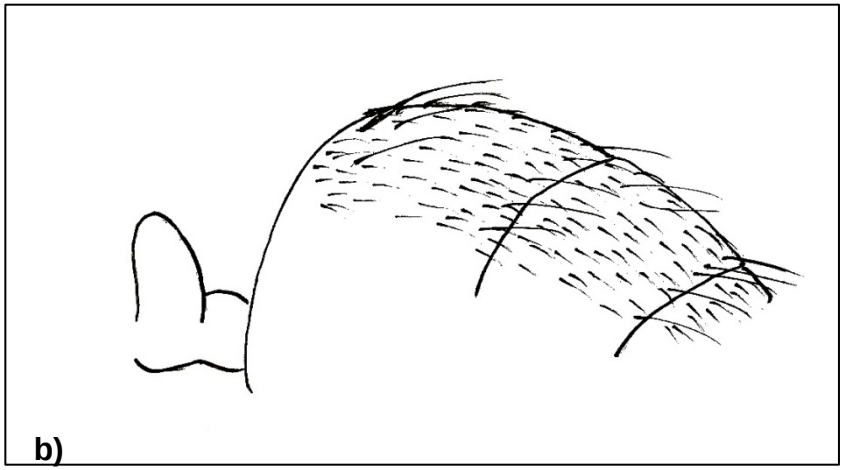


Figure 45.

42 (41)	Pubescence on gaster fine and sparse (a). Thorax and petiole evenly red; head and gaster dark red-black.	*Camponotus novaeboracensis* (Fitch)
42’	Pubescence on gaster more coarse and dense (b). Thorax darker dorsally; petiole red; head and gaster dark red-black.	*Camponotus modoc* Wheeler

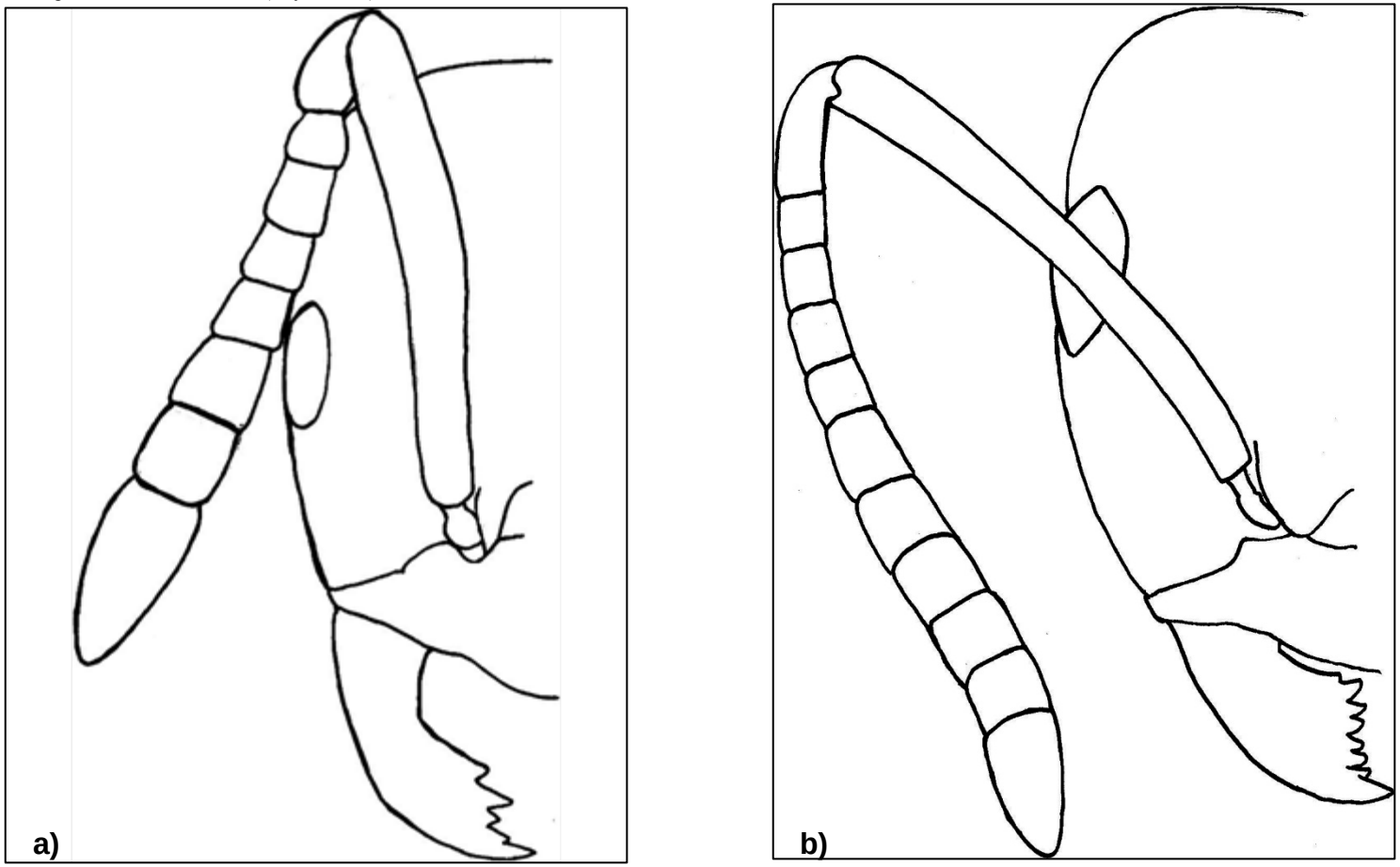


Figure 46.

43 (37)	Antenna with nine segments (a). (Genus *Brachymyrmex*).	44
43’	Antenna with more than nine segments (b).	45

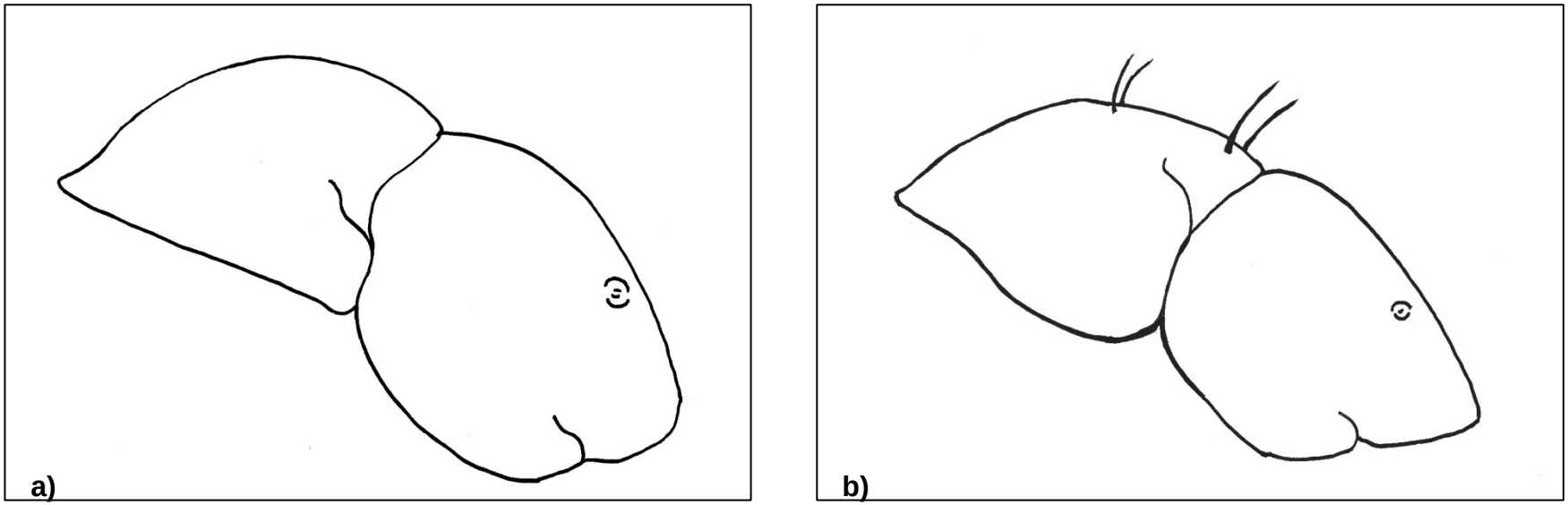


Figure 47.

44 (43)	Lacking erect setae on pronotum (a). Light yellow in colour.	*Brachymyrmex depilis* Emery
44’	Erect setae on pronotum (b). Light to dark brown/grey in colour.	*Brachymyrmex obscurior* Forel

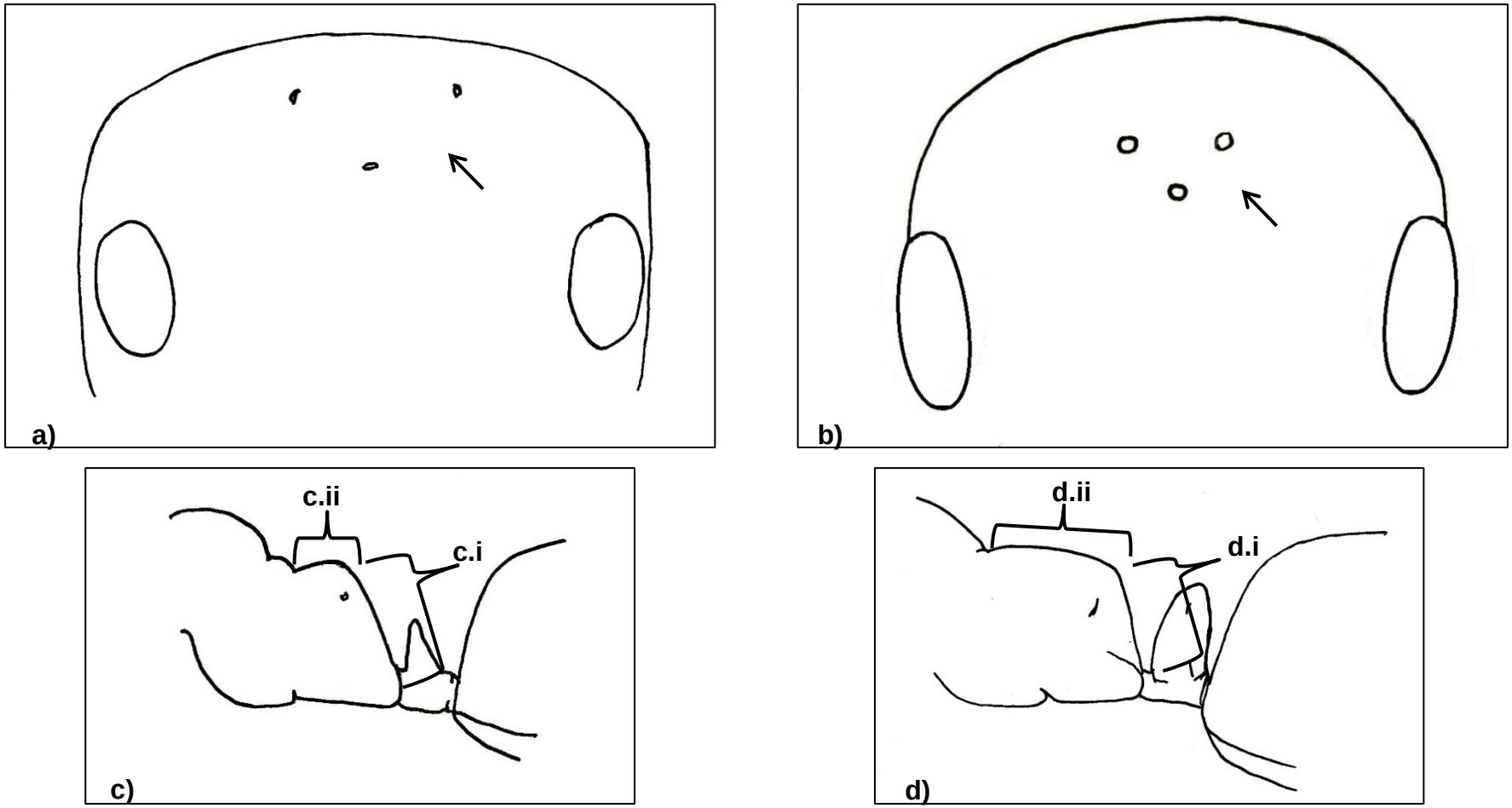


Figure 48.

45(43)	Ocelli very small(a). Posterior surface (c.i) of propodeum obviously longer than dorsal surface (c.ii). (Genus *Lasius*).	46
45’	Ocelli larger, obvious (b). Posterior surface of the propodeum (d.i) shorter than or equal to dorsal surface (d.ii). (Genus *Formica*).	57

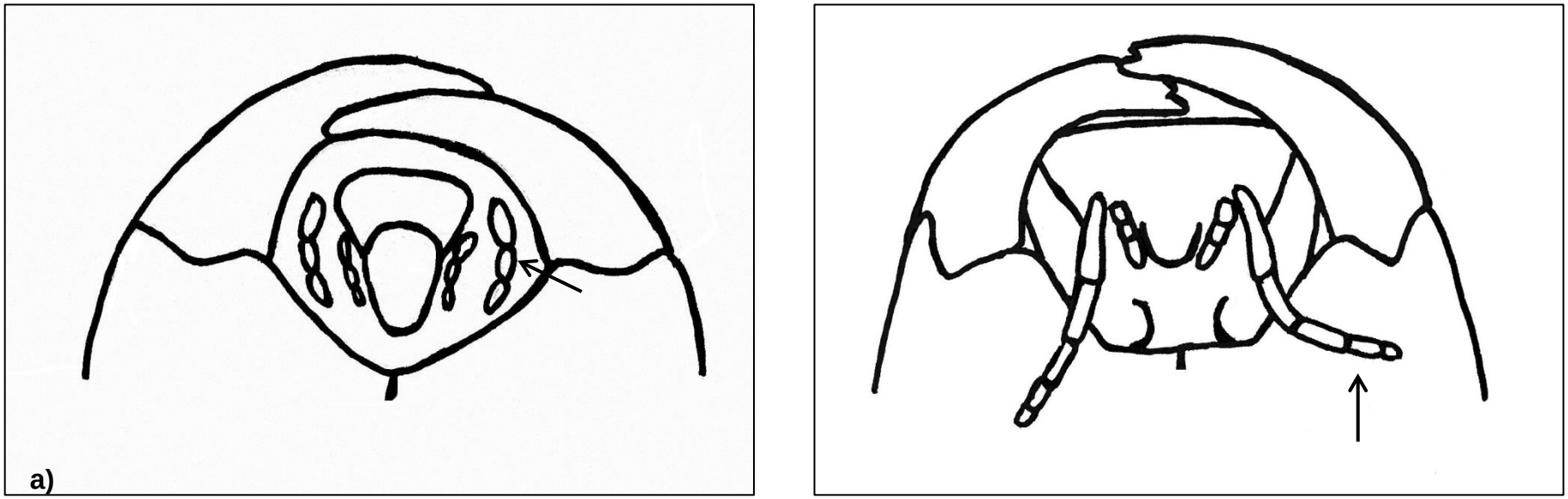


Figure 49.

46 (45)	Maxillary palp with 3 segments although palps may be small and sometimes difficult to see (a).(Subgenus *Acanthomyops*).	47
46’	Maxillary palpal with 5 segments, and usually apparent in ventral view (b).	49

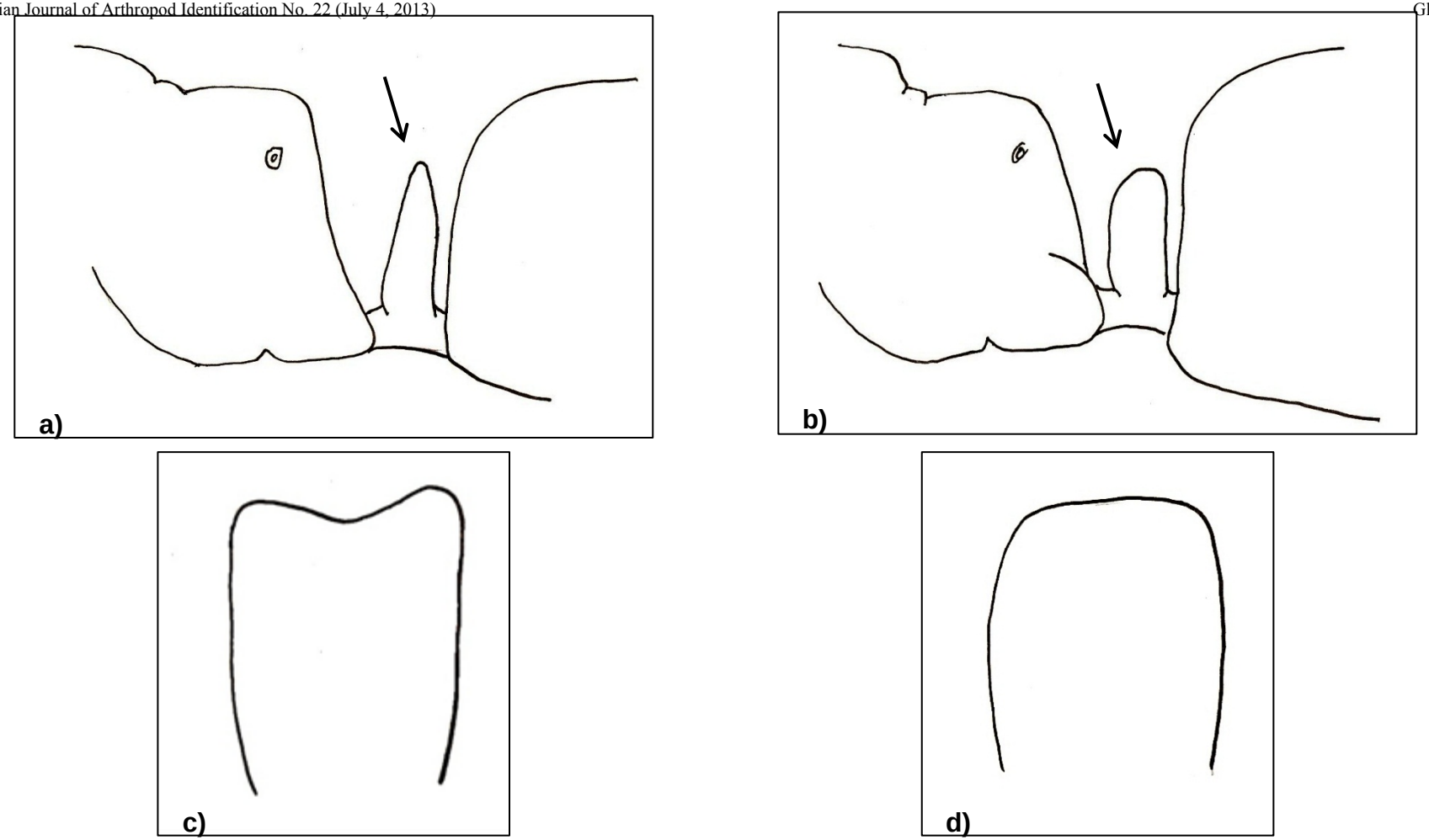


Figure 50.

47 (46)	Petiolar crest sharp in profile view (a); in posterior view with a distinct mid-dorsal notch (c).	*Lasius coloradensis* Wheeler
47’	Petiolar crest blunt to moderately blunt in profile view (b); in posterior view without distinct notch, but sometimes faintly concave (d).	48

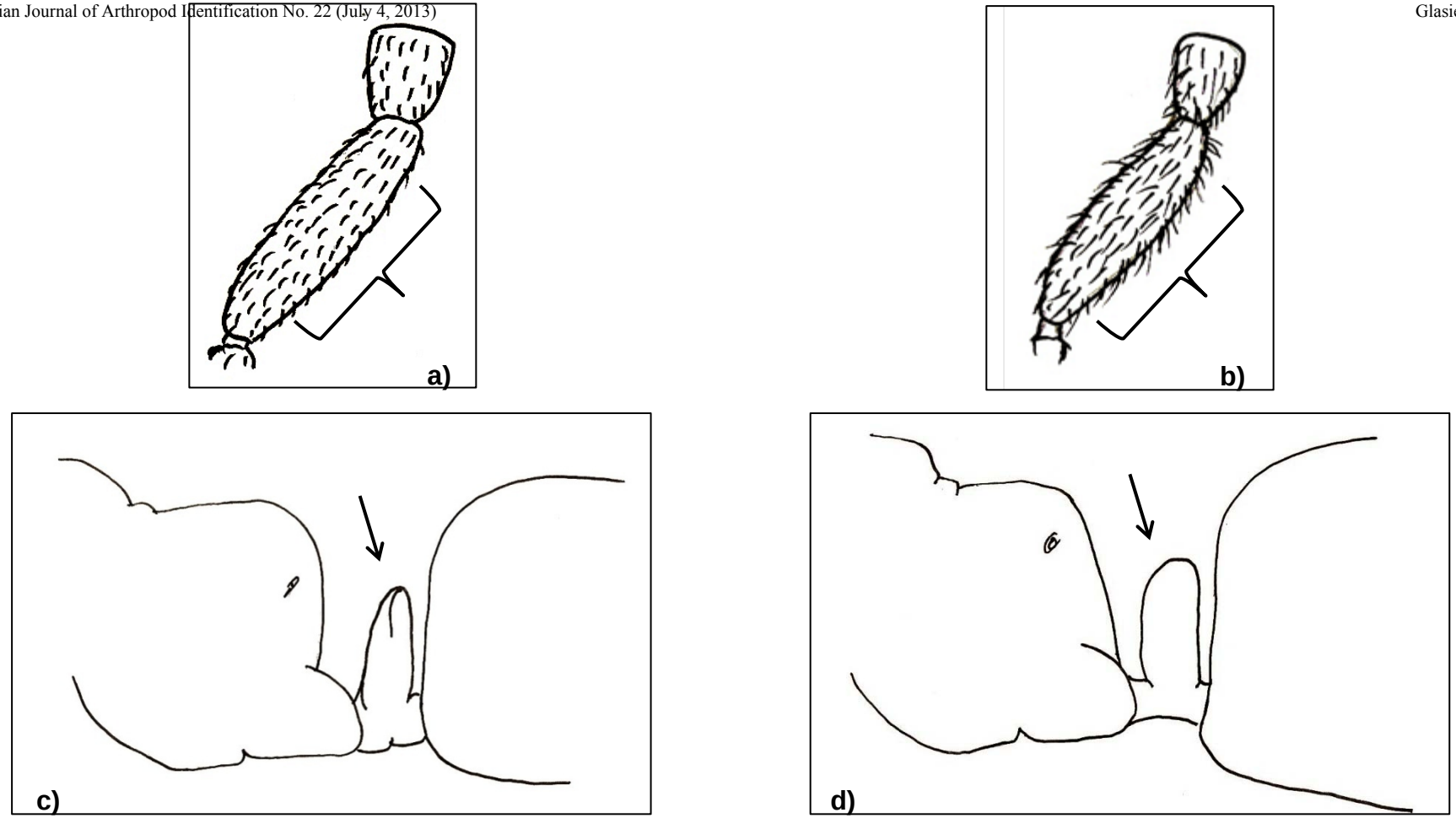


Figure 51.

48 (47)	Profemora with erect setae confined to the flexor surface (a). Petiolar scale moderately blunt (c).	*Lasius subglaber* Emery
48’	Profemora with erect setae on lateral surface as well as flexor surface (b). Petiolar scale distinctly blunt (d).	*Lasius latipes* (Walsh)

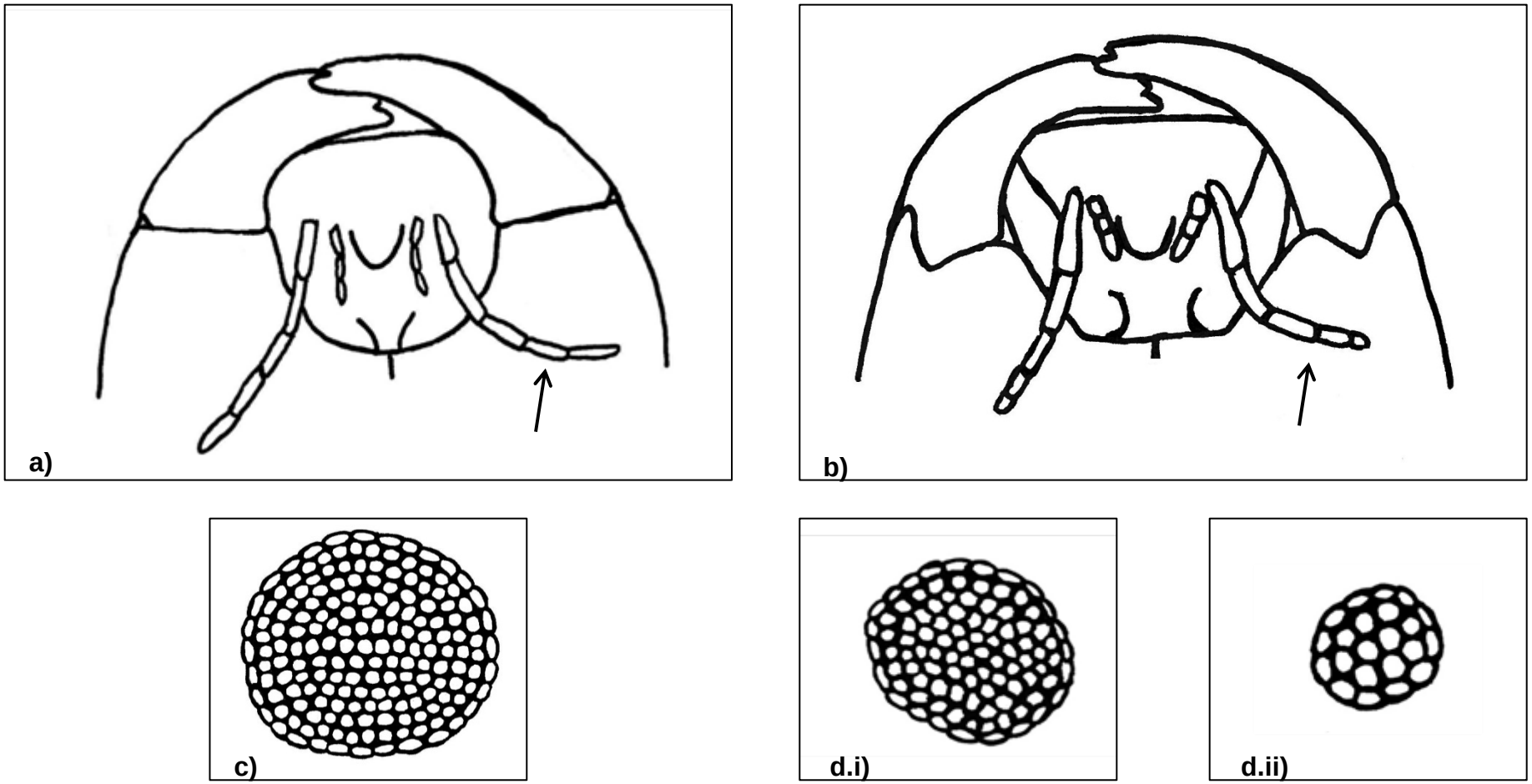


Figure 52.

49 (46)	Last three segments of maxillary palp equal or sub-equal in length (a). Eyes large, with more than 12 ommatidia at maximum diameter (c). (Subgenus *Lasius*).	50
49’	Last three segments of maxillary palp each decreasing in length (b). Eyes small, with 12 or fewer ommatidia at maximum diameter (d.i, d.ii).	54

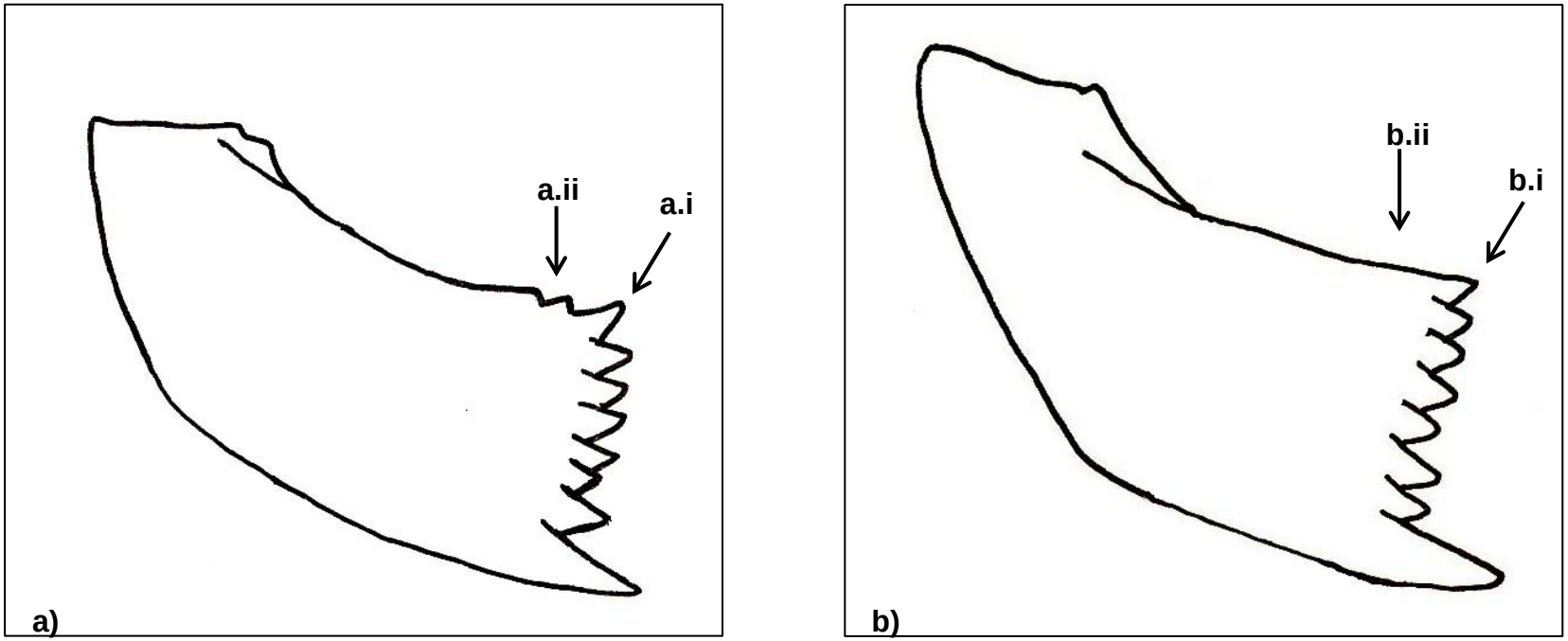


Figure 53.

50(49)	Posterior mandibular tooth deflected posteriorly (a.i), small teeth present along basal margin of at least one of the two mandibles (a.ii).	*Lasius pallitarsis* (Provancher)
50’	Basal mandibular tooth not deflected posteriorly (b.i) and mandible lacking teeth along basal margin (b.ii).	51

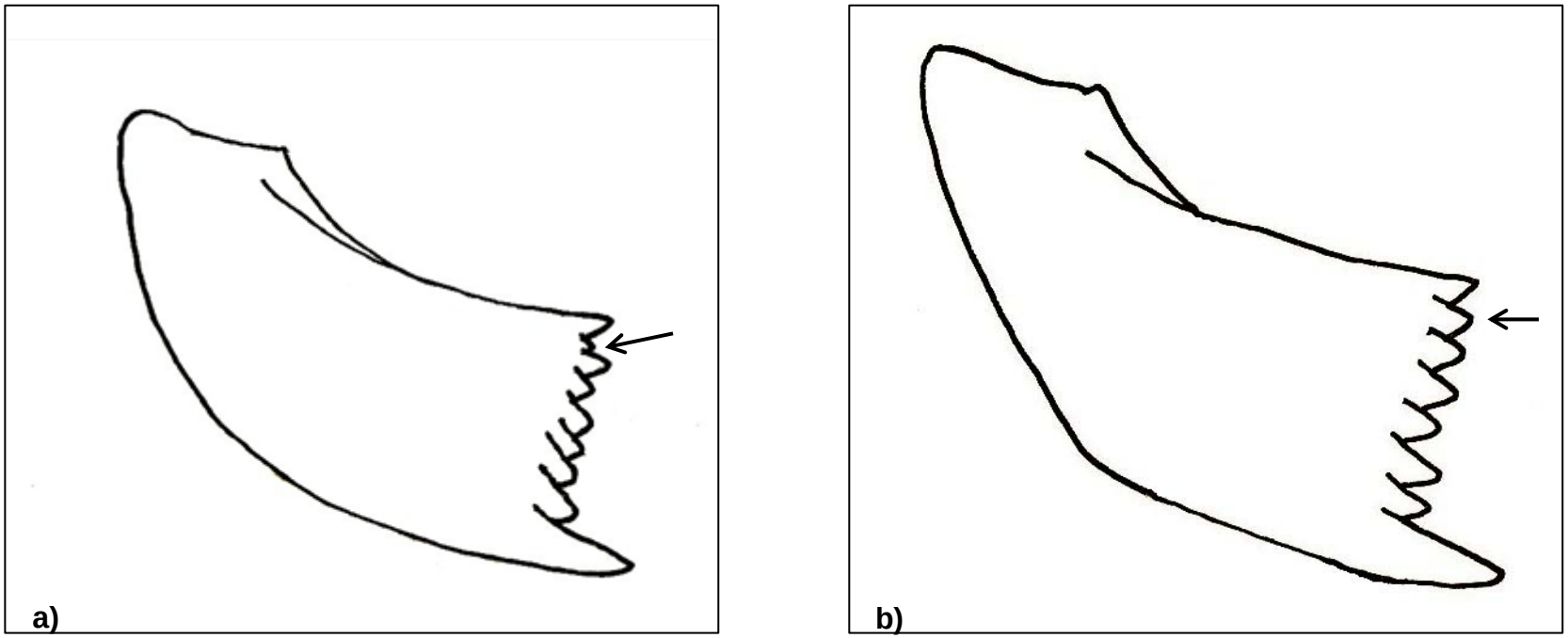


Figure 54.

51 (50)	On at least one mandible, sub-basal tooth noticeably smaller compared to basal tooth, or a prominent gap present between the two (a).	52
51’	On both mandibles, sub-basal and basal tooth about equal in size with no discernable gap between them (b).	53

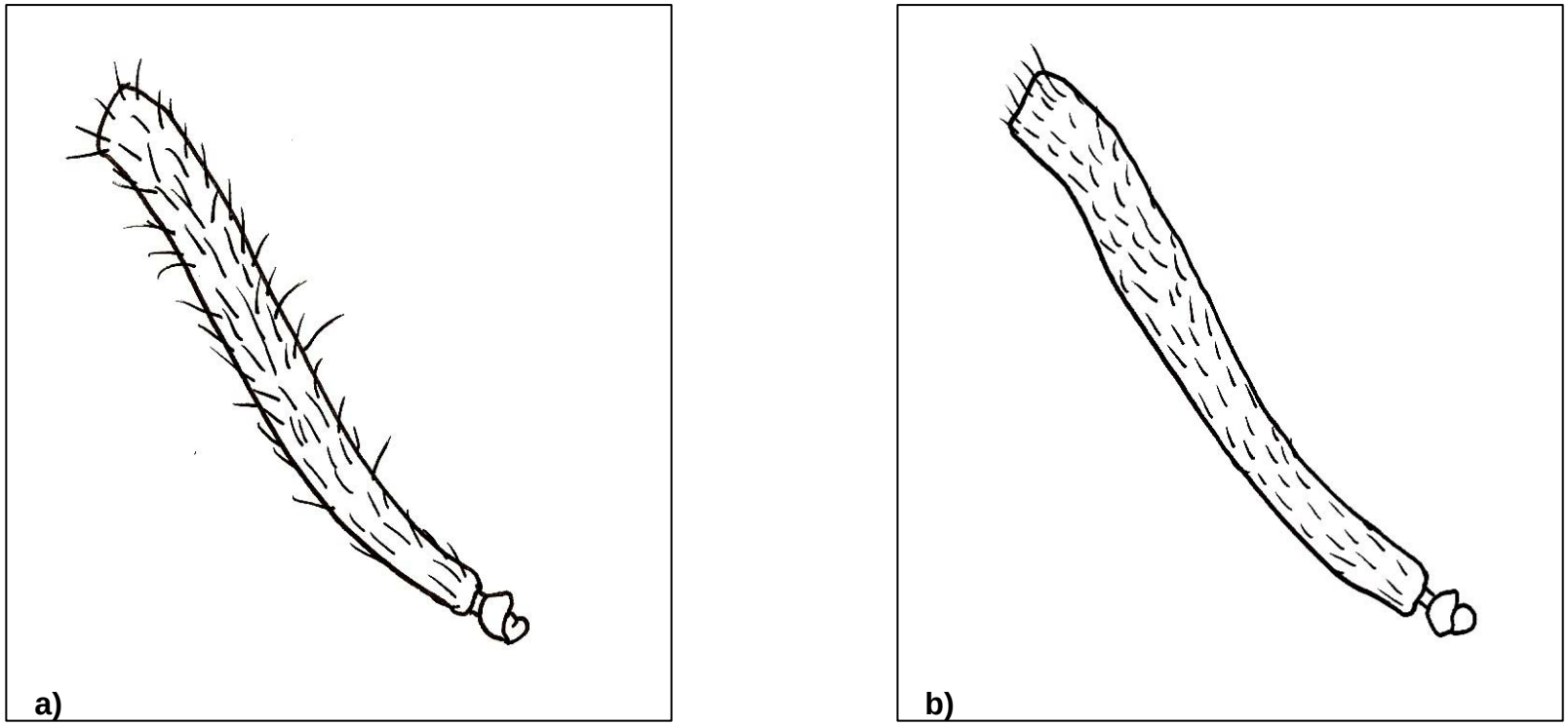


Figure 55.

52 (51)	Scape with numerous erect and decumbent setae (a).	*Lasius neoniger* Emery
52’	Scape without erect or decumbent (except on extreme tip), although numerous appressed setae are present (b).	*Lasius crypticus* Wilson

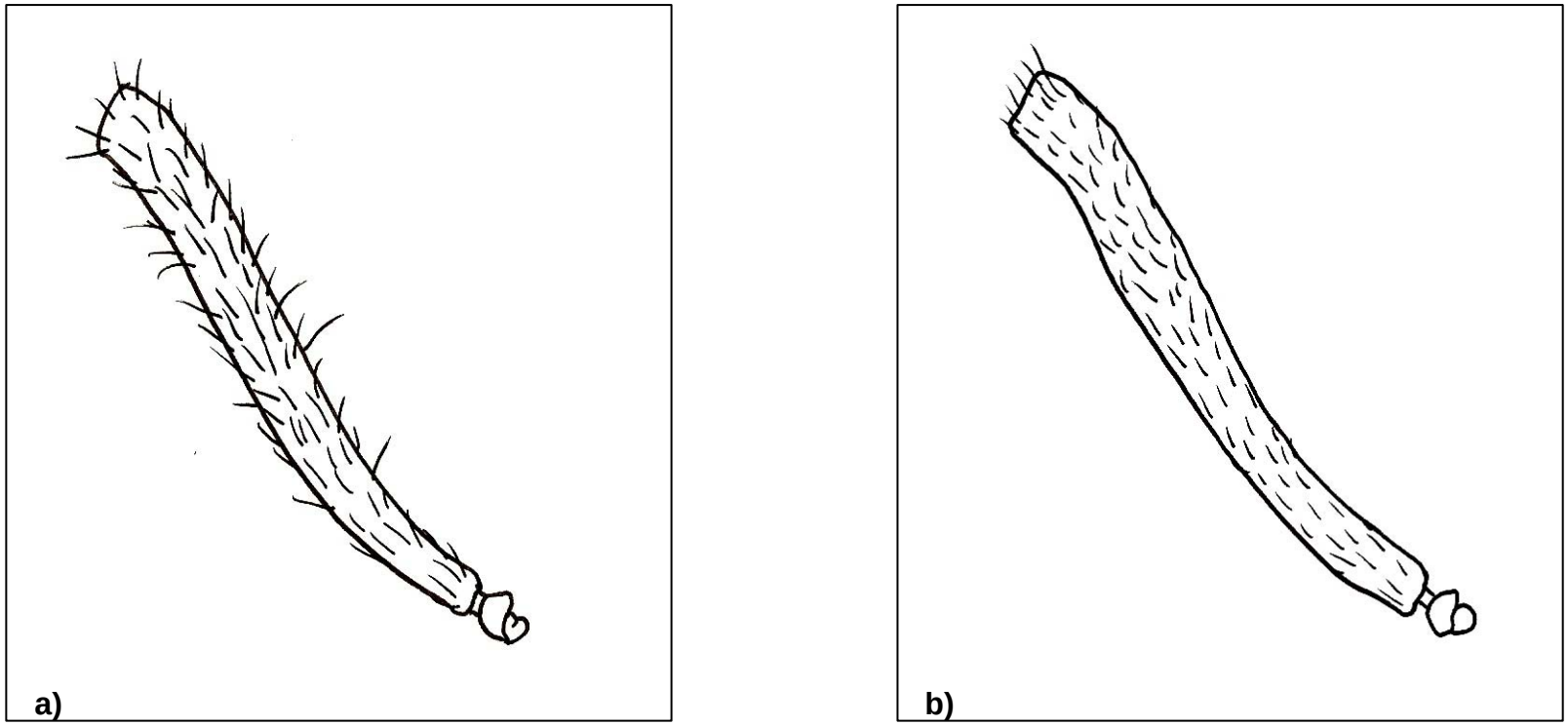
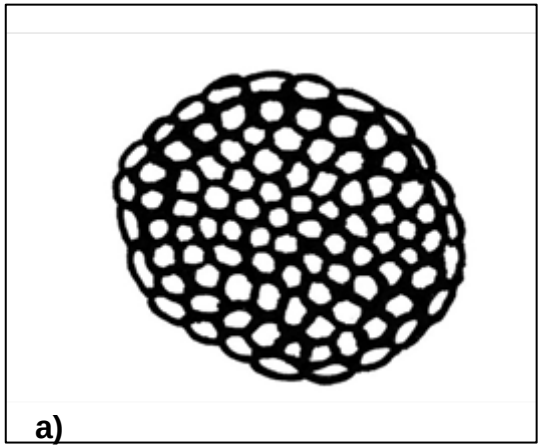


Figure 56.

53 (51)	Scape with numerous erect and decumbent setae (a).	*Lasius niger* (Linnaeus)
53’	Scape without erect or decumbent setae (except on extreme tip), although numerous appressed setae are present (b).	*Lasius alienus* (Förster)



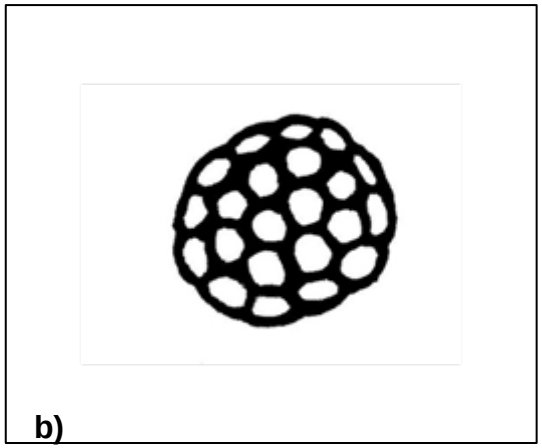


Figure 57.

54 (49)	Eyes small, but ommatidia often easy to differentiate and with 10 to 12 ommatidia at maximum diameter (a). (Subgenus *Chthonolasius*).	55
54’	Eyes small, ommatidia relatively hard to differentiate, and with six or fewer ommatidia at maximum diameter (b). (Subgenus *Cautolasius*).	56

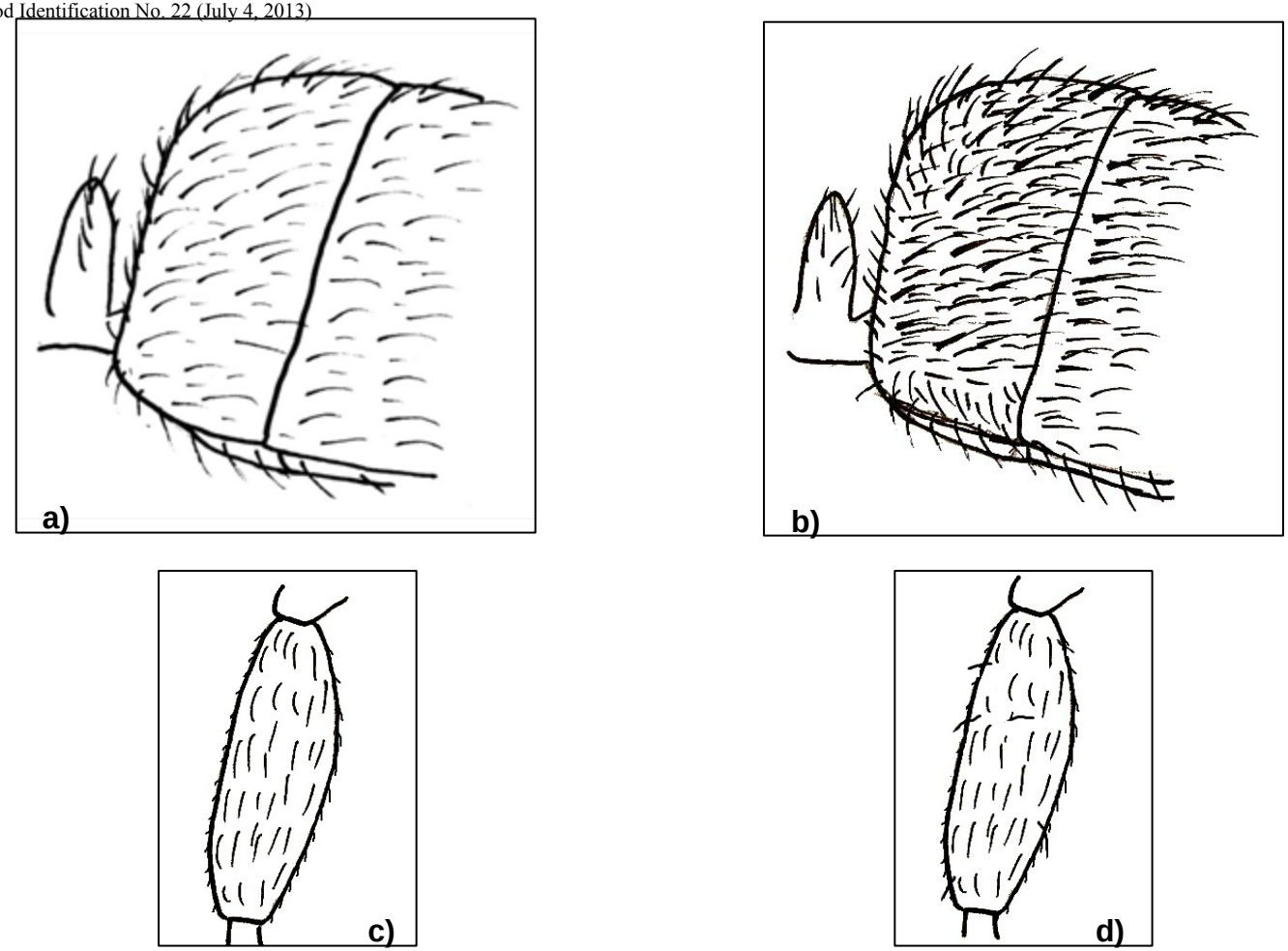
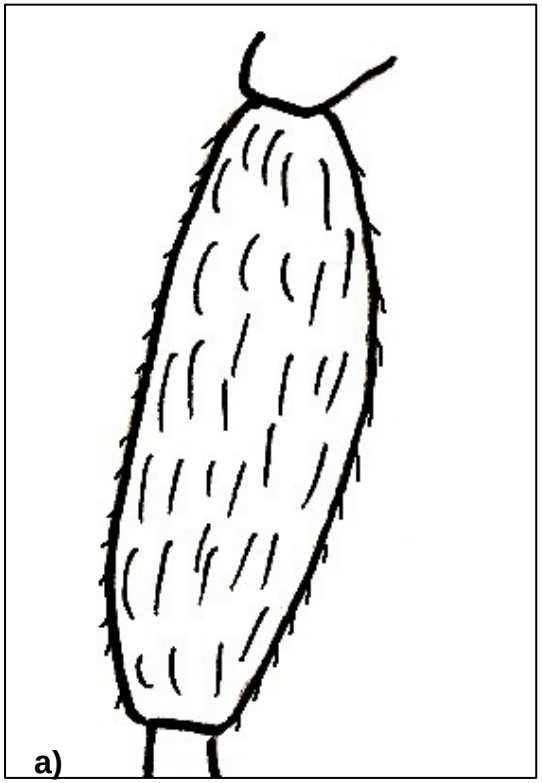


Figure 58.

55 (54)	Dorsal surface of gaster with sparse pubescence (a). Gaster only faintly shiny. Outer surface of each tibia with appressed setae, but without erect setae (c).	*Lasius umbratus* (Nylander)
55’	Dorsal surface of gaster with dense underlying pubescence (b). Gaster moderately shiny. Outer surface of each tibia with a few decumbent and erect setae (d).	*Lasius subumbratus* Viereck



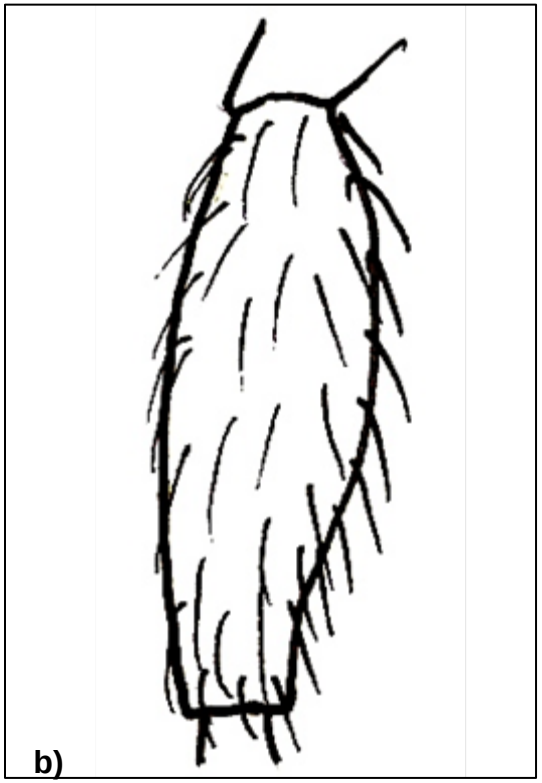


Figure 59.

56 (54)	Outer surface of each tibia with appressed setae, but without erect setae (a).	*Lasius flavus* (Fabricius)
56’	Outer surface of each tibia with numerous decumbent and erect setae (b).	*Lasius fallax* Wilson

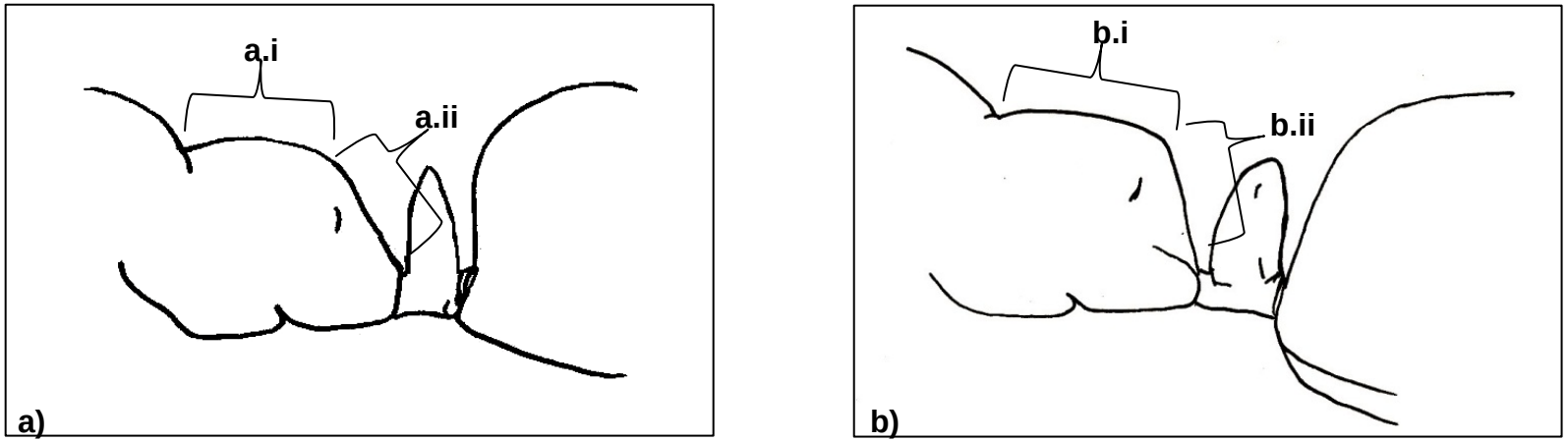


Figure 60.

57 (45)	Typically shiny in entirety. Pubescence on body and gaster very sparse; density of erect setae variable. In profile, angle between dorsal and posterior surfaces of propodeum typically forming a continuous rounded profile (a.i and a.ii). Dorsal (a.i) and posterior (a.ii) surfaces of propodeum about equal length. Habitus gracile. (*Formica neogagates* species group).	58
57’	Typically dull; if shiny, gaster dull. Pubescence on body and gaster variable, but more dense then above; density of erect setae variable. In profile, angle between dorsal and posterior surfaces of propodeum typically forming a more distinct angle (b.i and b.ii). Dorsal surface typically longer (b.i) than posterior surface of propodeum (b.ii). Habitus robust.	62

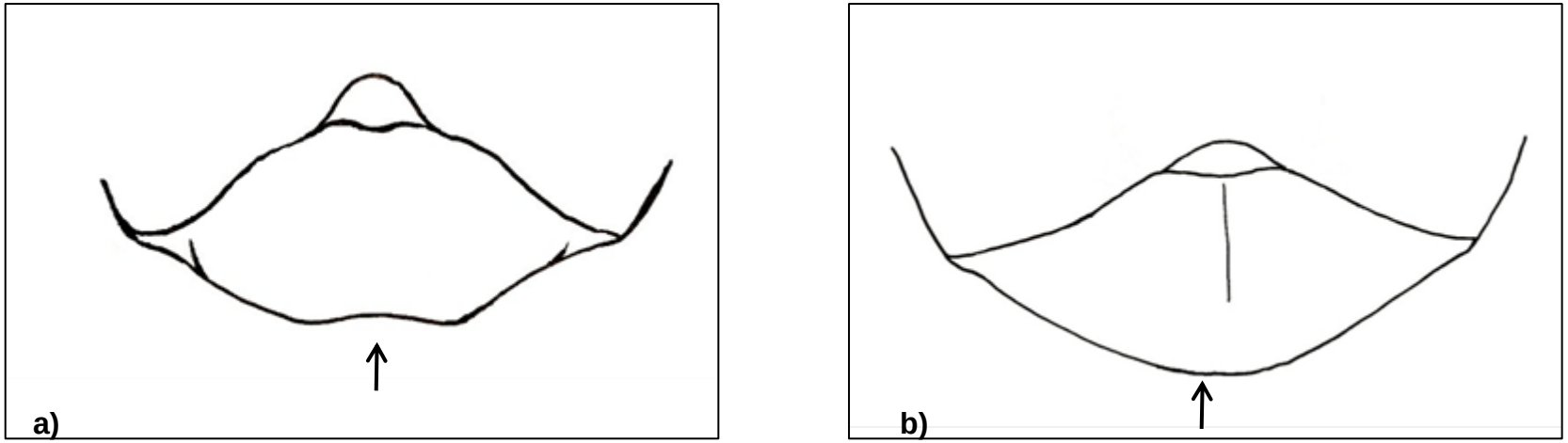


Figure 61.

58 (57)	Anterior margin of clypeus concave or notched (a).	59
58’	Anterior margin of clypeus convex (b).	60

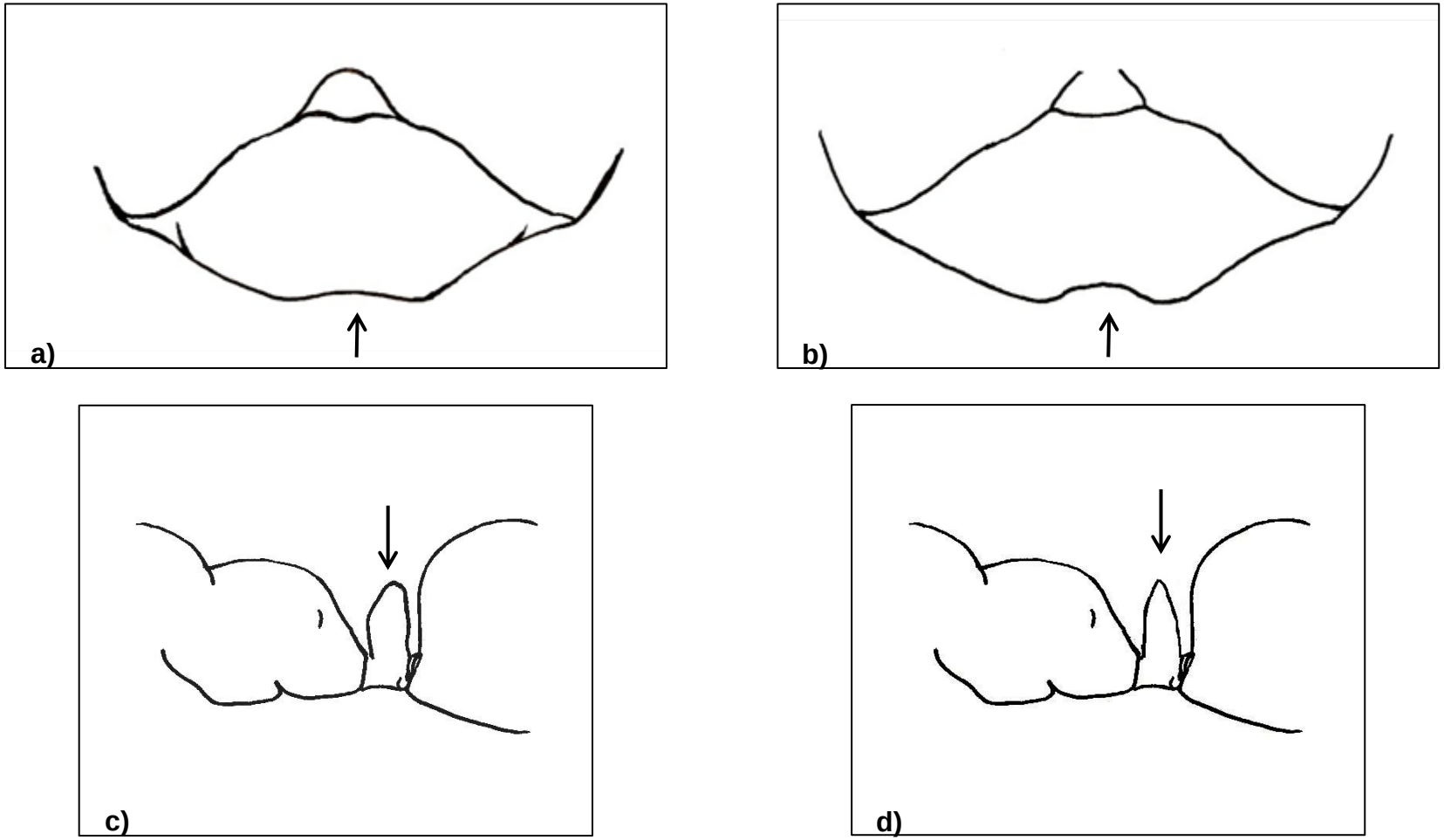


Figure 62.

59 (58)	Anterior margin of clypeus concave (a). Petiole thick in profile (c). Reddish-yellow in colour. Gaster no darker than head and thorax.	*Formica bradleyi* Wheeler
59’	Anterior margin of clypeus notched (b). Petiole thin in profile (d). Gaster darker than head and thorax.	*Formica perpilosa* Wheeler

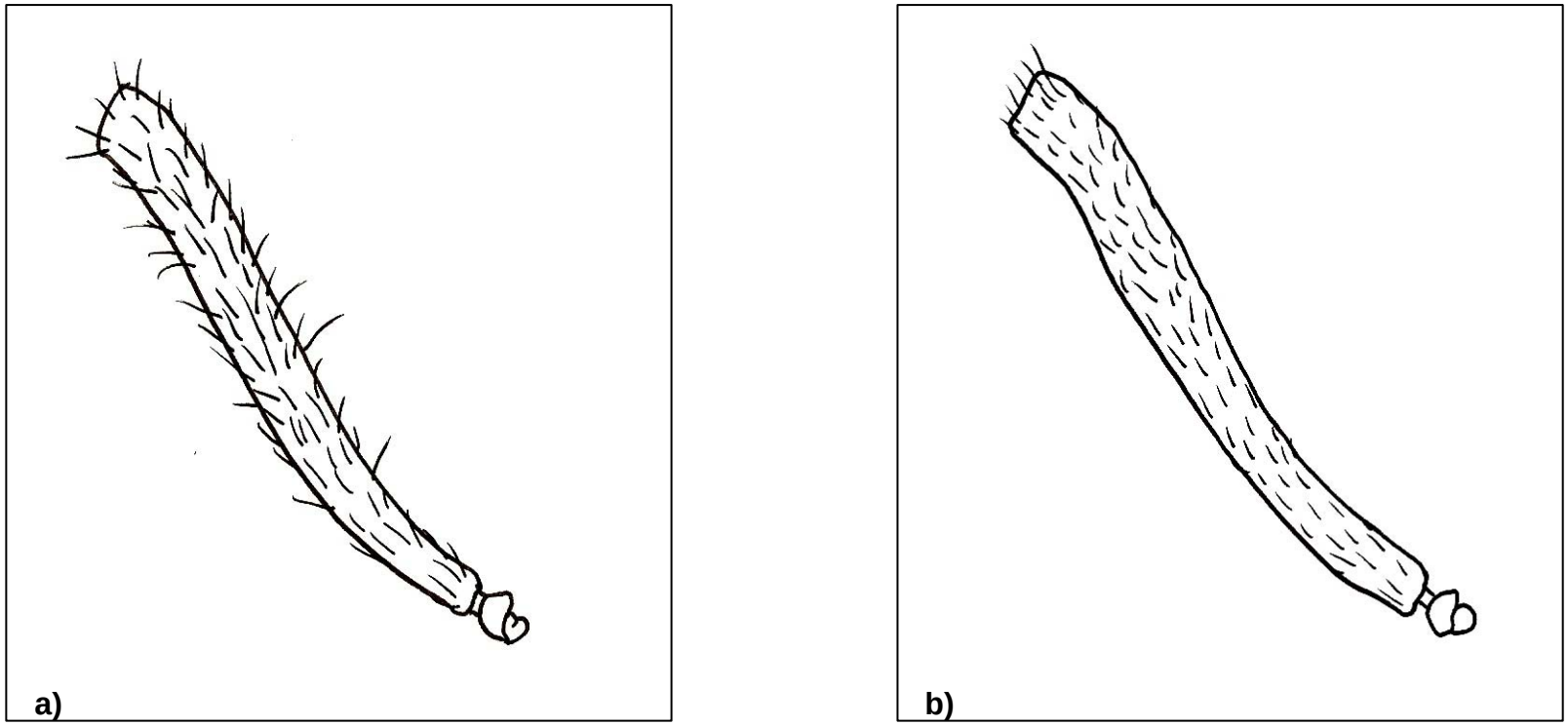
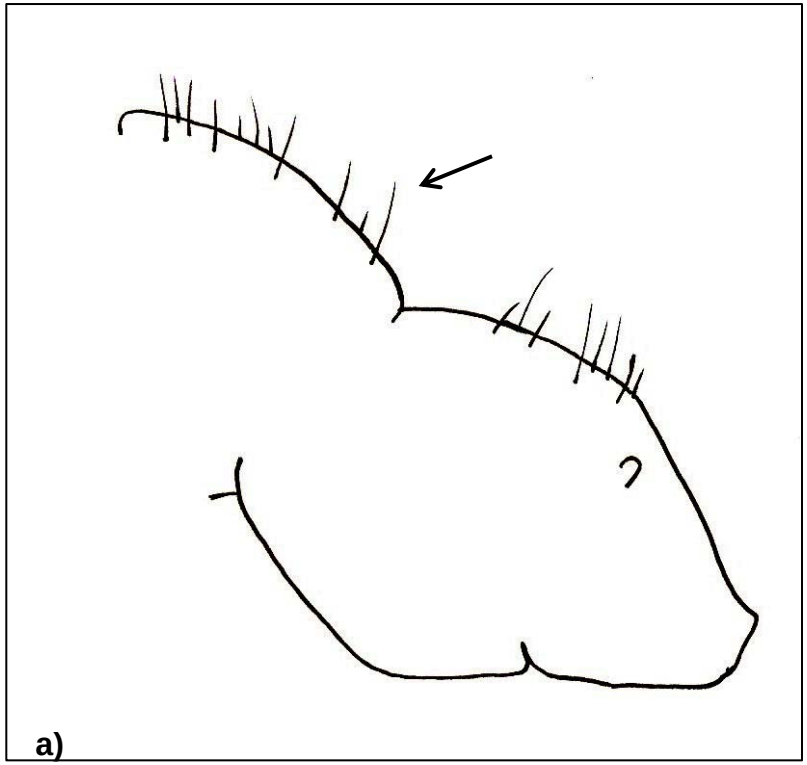


Figure 63.

60 (58)	Scape with several erect setae (a).	*Formica lasioides* Emery
60’	Scape without erect setae; except for a small cluster at extreme tip (b).	61



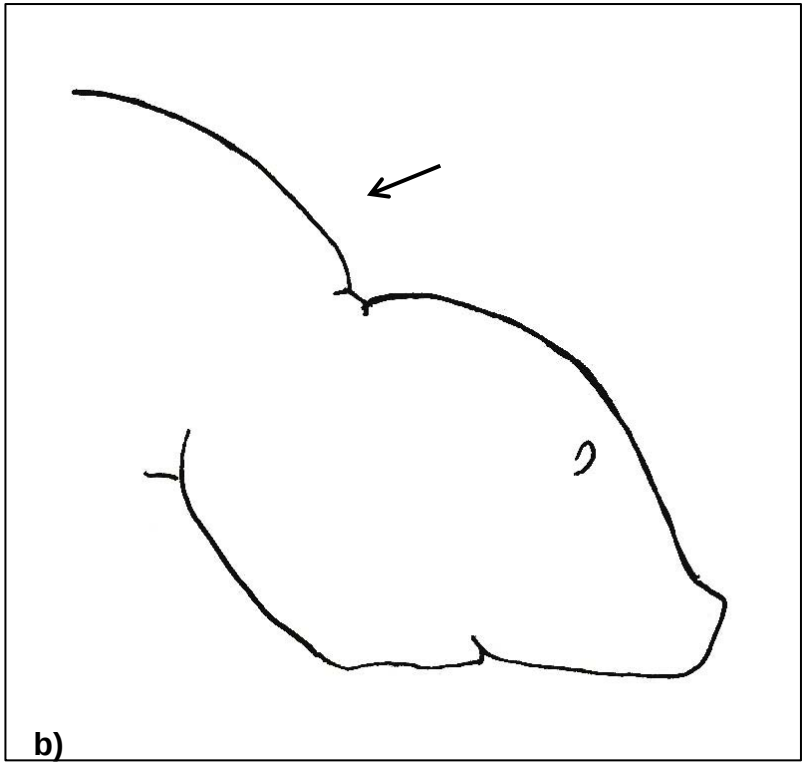


Figure 64.

60 (59)	Mesosoma with numerous erect setae (a). Moderately shiny.	*Formica neogagates* Viereck
60’	Mesosoma without erect setae (sometimes one or two) (b). Strongly shiny.	*Formica limata* Wheeler

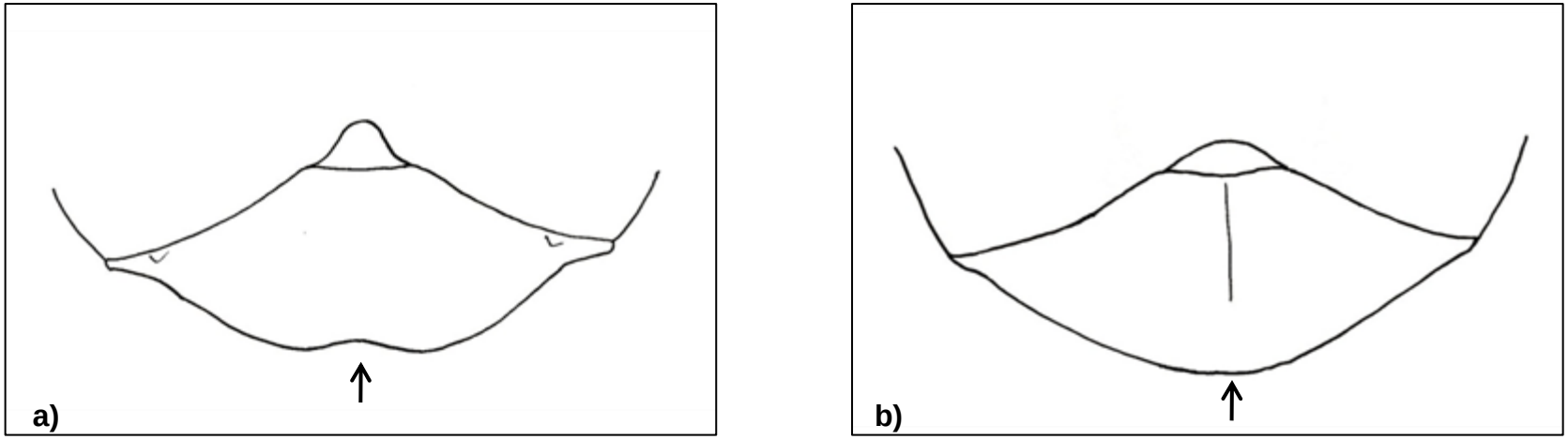


Figure 65.

62 (57)	Clypeus with concave anteromedian margin (a). (*Formica sanguinea* species group).	63
62’	Clypeus with rounded anteromedian margin (b).	66

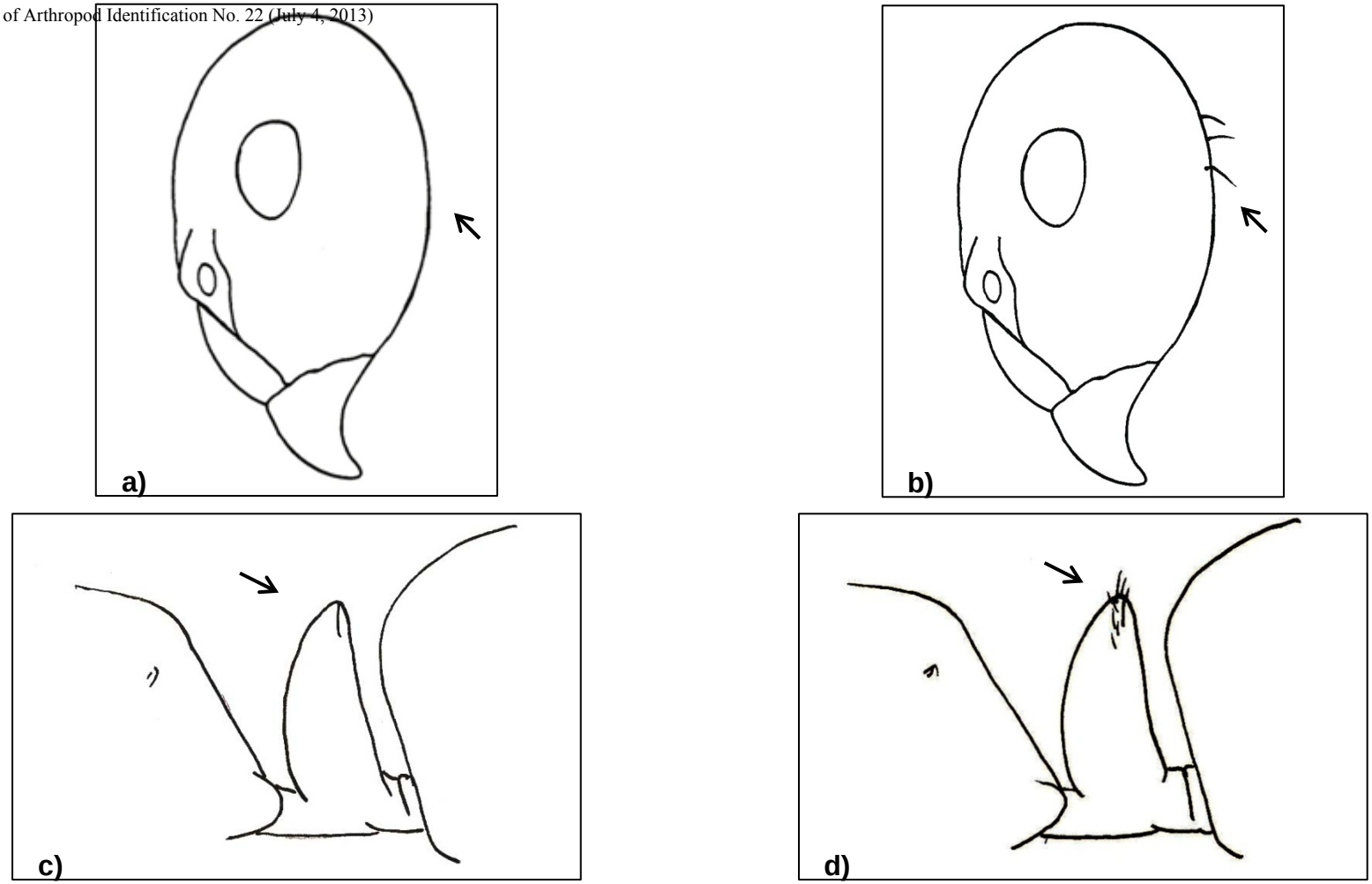


Figure 66.

63 (62)	Underside of head (a) and crest of petiole without erect setae (c).	64
63’	Underside of head (b) and crest of petiole with erect setae (d).	65

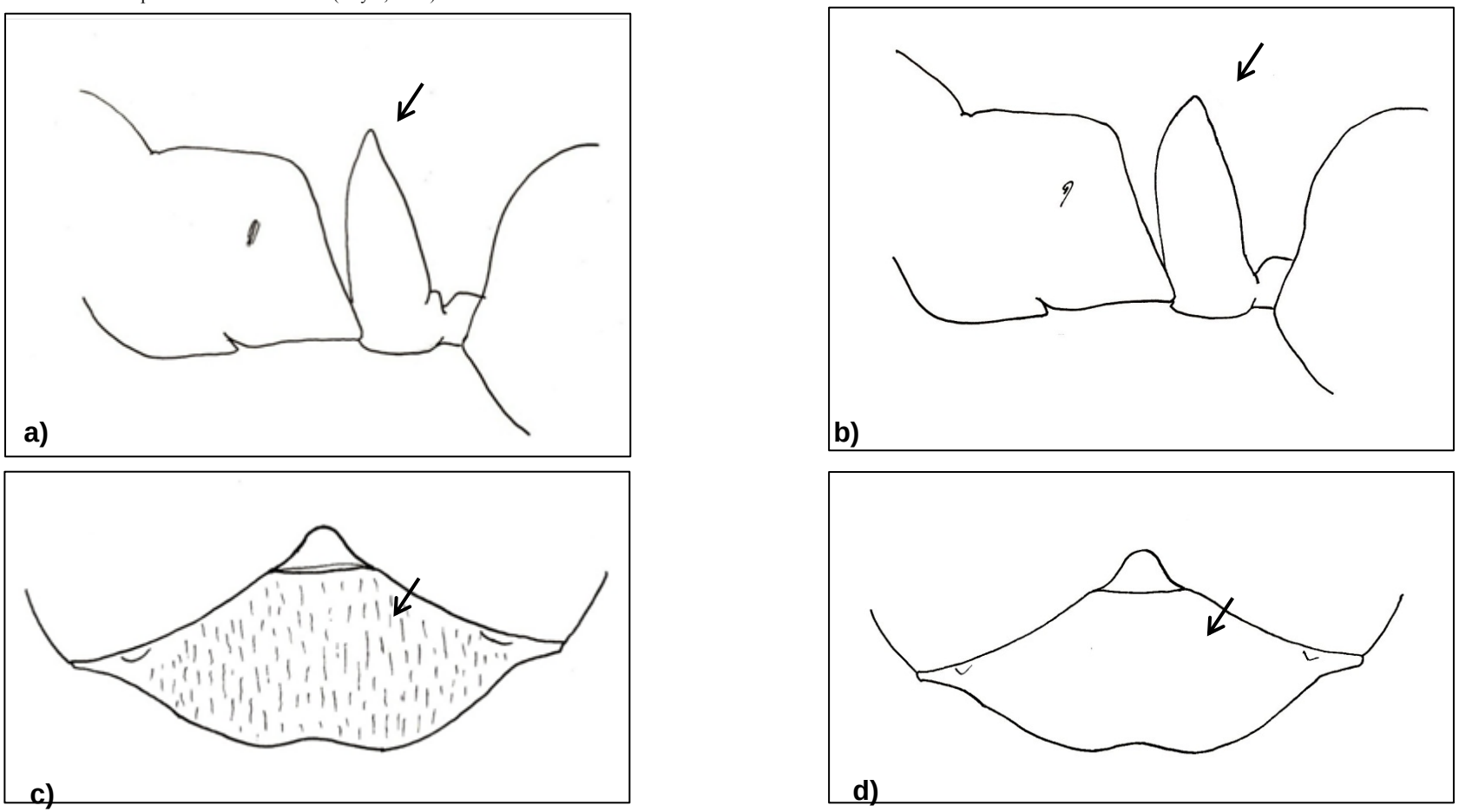


Figure 67.

64 (63)	In profile, apex of petiole sharp (a). Clypeus with fine striae (c).	*Formica aserva* Forel
64’	In profile, apex of petiole slightly blunt (b). Clypeus without striae (d).	*Formica emeryi* Krausse

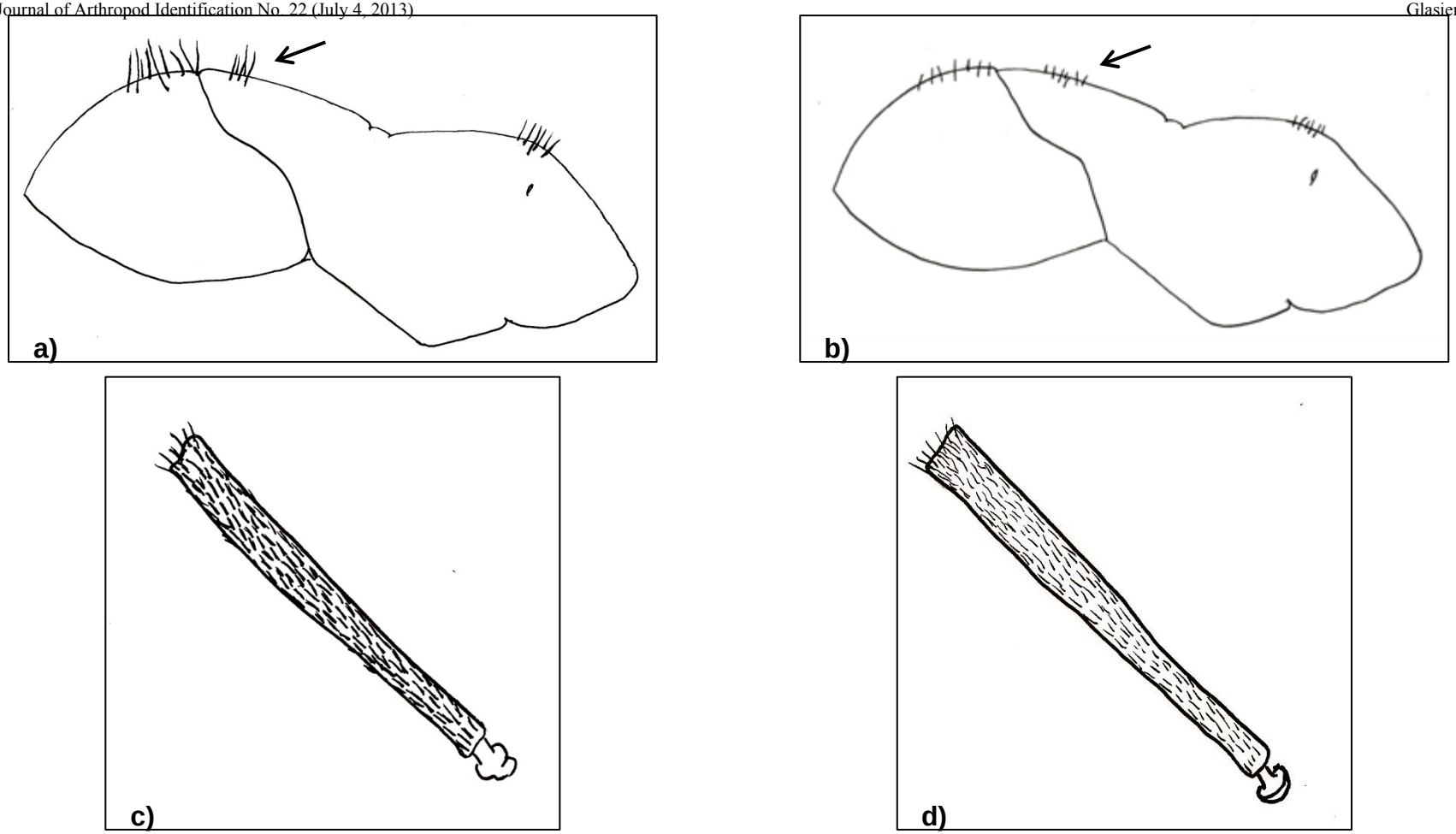


Figure 68.

65 (63)	Erect setae of thorax long (0.10 - 0.25mm and evenly tapering to the apex (a). Pubescence on scape coarse (c).	*Formica puberula* Emery
65’	Erect setae of thorax short (0.06 - 0.14mm) and blunt or abruptly tapering at apex (b). Pubescence on scape fine (d).	66

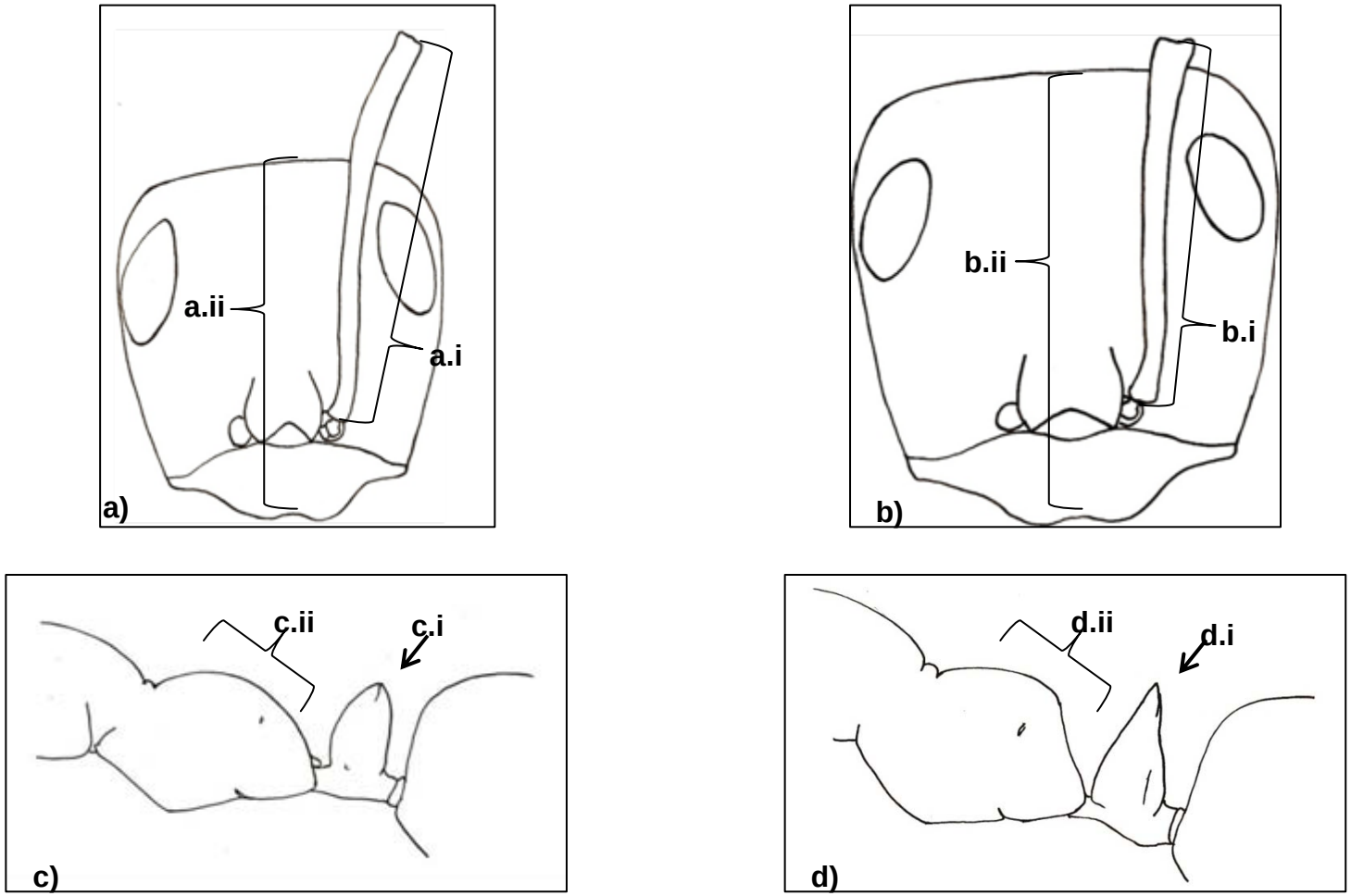
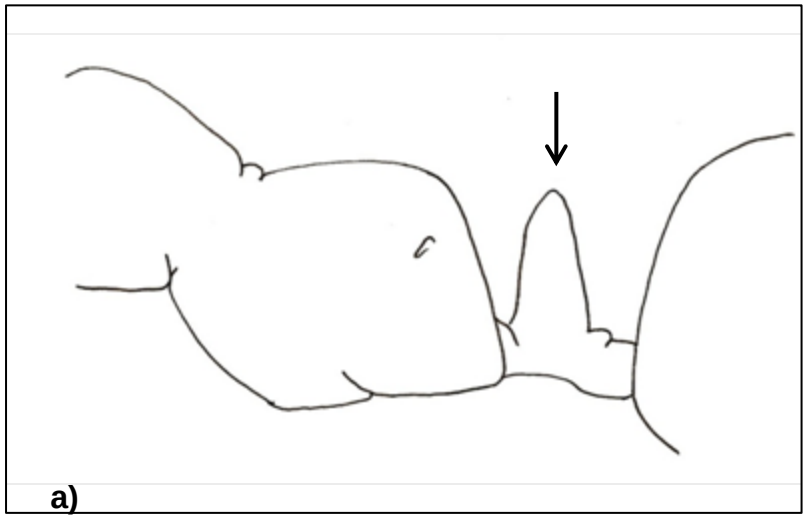


Figure 69.

66 (65)	Scape (a.i) longer than head length (a.ii). In profile, apex of petiole blunt (c.i), and propodeum broadly rounded (c.ii).	*Formica obtusopilosa* Emery
66’	Scape (b.i) shorter than head length (b.ii). In profile apex of petiole sharp or blunt (d.i), and propodeum more angulate (d.ii).	67



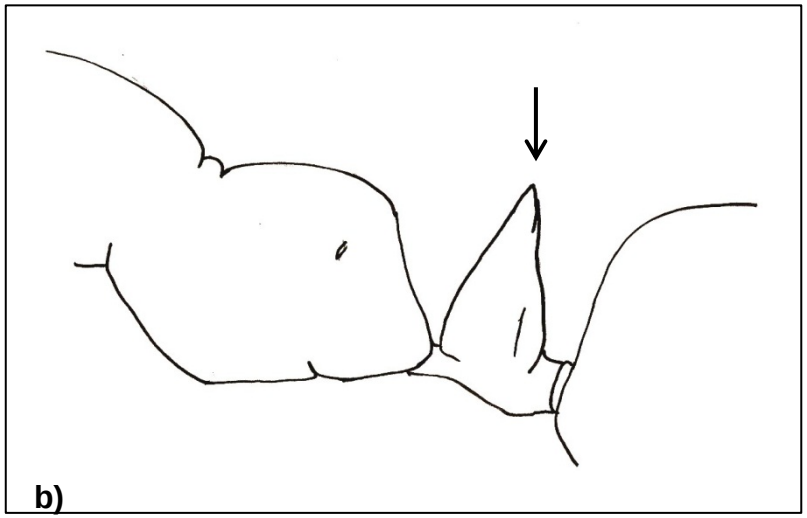


Figure 70.

67 (66)	In profile, apex of petiole moderately blunt (a).	*Formica subintegra* Wheeler
67’	In profile, apex of petiole sharp (b).	*Formica rubicunda* Emery

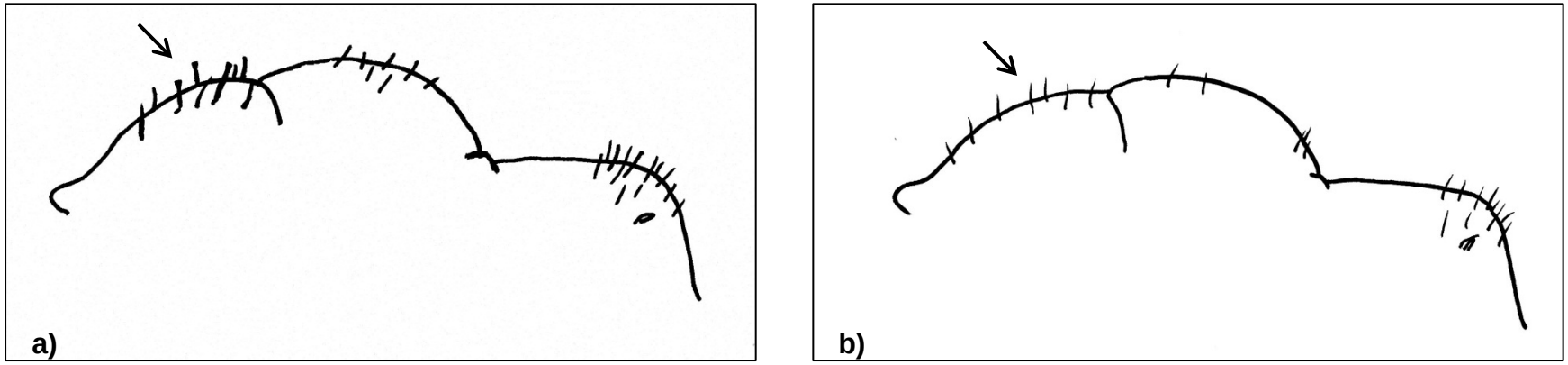


Figure 71.

68 (62)	Erect setae on pronotum thick, sometimes clavate or truncate at apex (a); density variable. Queens smaller than the largest worker. (*Formica microgyna* species group).	69
68’	Erect setae on pronotum fine, not clavate at apex (b); density variable. Queens same size or larger than largest workers.	72

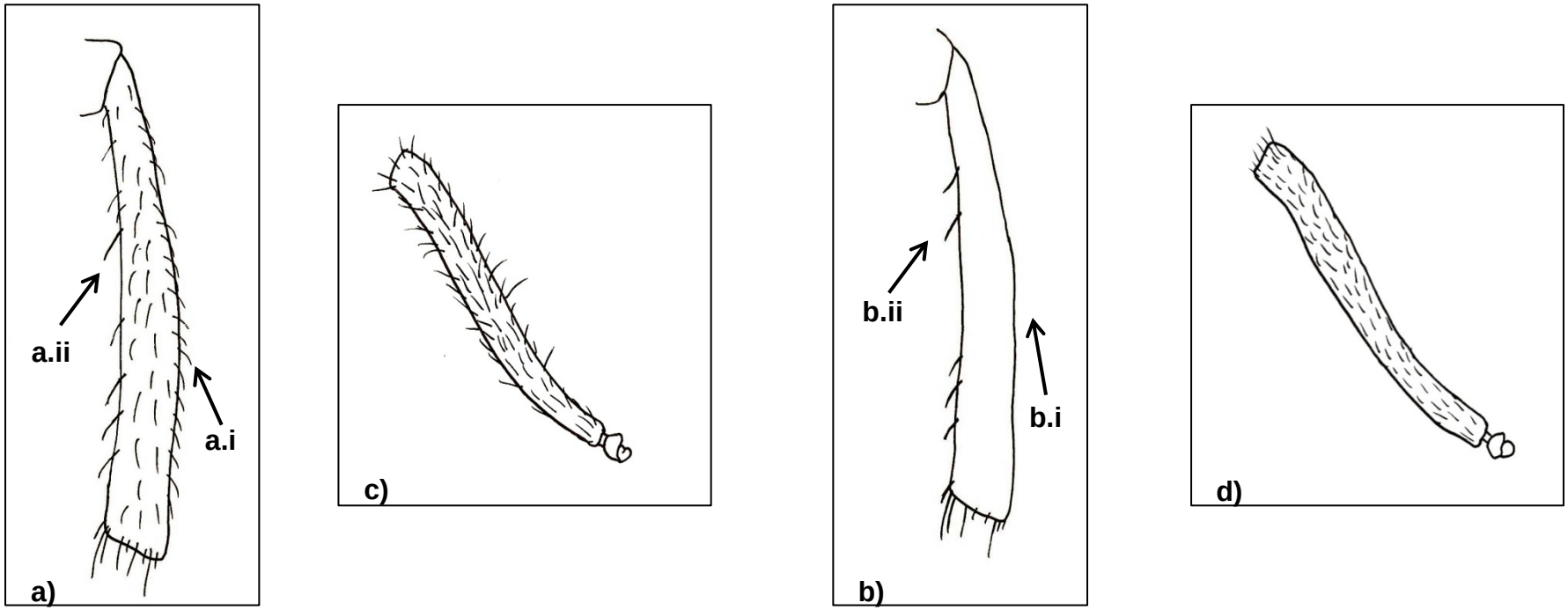


Figure 72.

69 (68)	Tibia with erect setae (a.i) in addition to double row on flexor surface (a.ii). Scape usually with erect setae (c).	70
69’	Tibia without erect setae (b.i) except for double row on flexor surface (b.ii). Scape always without erect setae except for extreme tip (d).	71

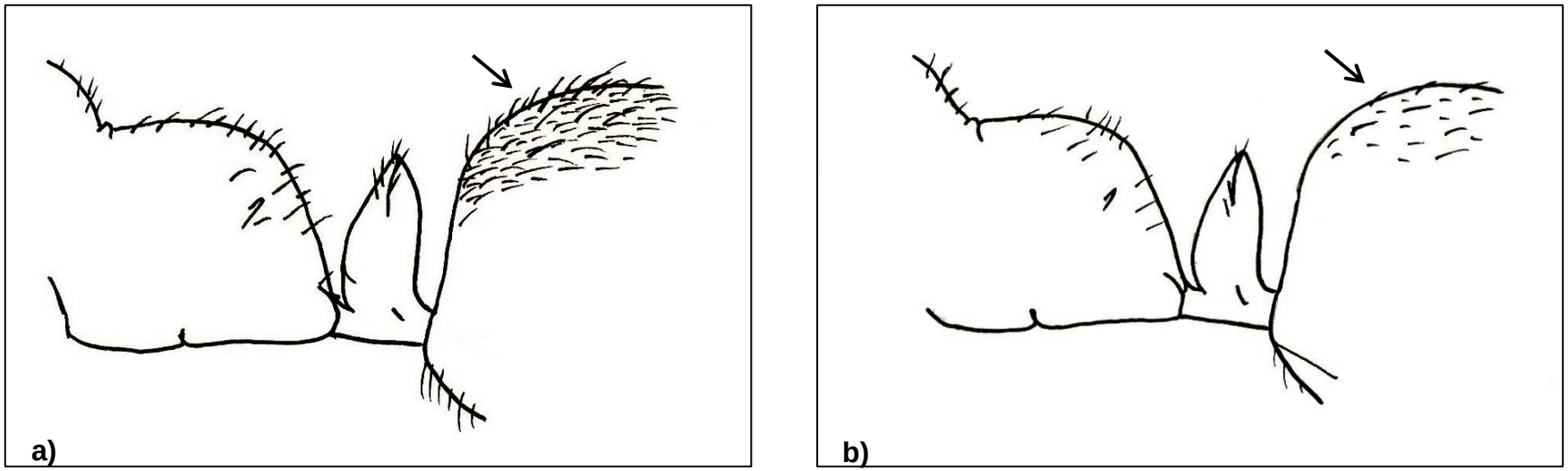


Figure 73.

70 (69)	Erect setae on gaster dense (a).	*Formica impexa* Wheeler
70’	Erect setae on gaster typically sparse (b).	*Formica microgyna* Wheeler

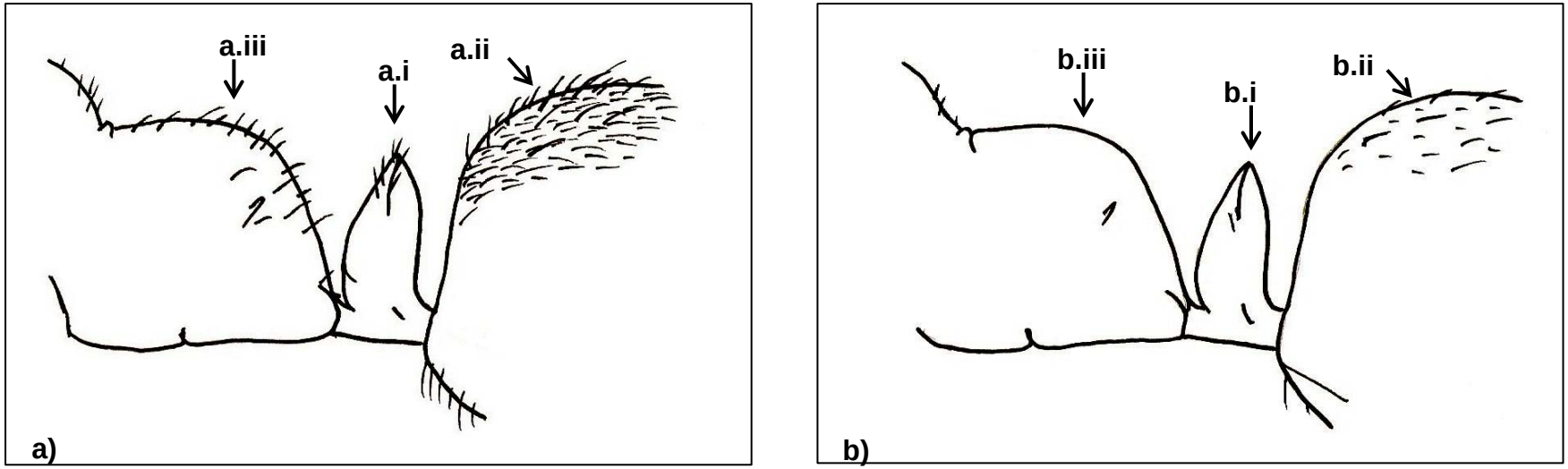
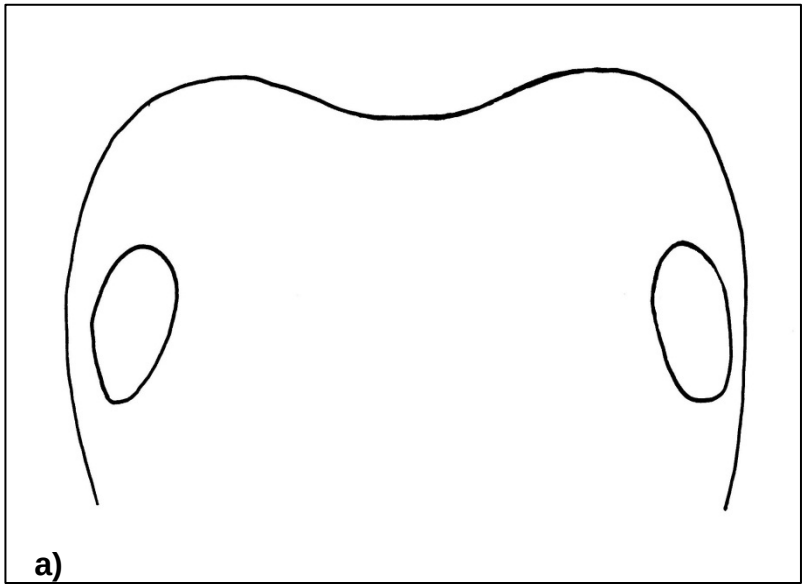


Figure 74.

71 (69)	Erect setae on apex of petiole (a.i). Pubescence on gaster dense (a.ii). Erect setae on dorsum of mesosoma numerous (a.iii).	*Formica densiventris* Viereck
71’	Erect setae absent from apex of petiole (b.i). Pubescence on gaster sparse (b.ii). Erect setae on dorsum of mesosoma sparse (b.iii).	*Formica adamsi* Wheeler



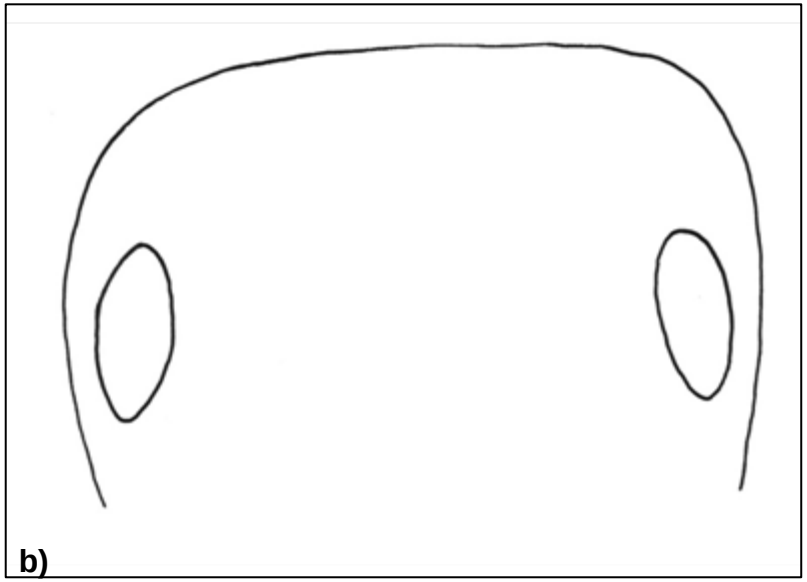


Figure 75.

72 (68)	In full face view, posterior margin of head distinctly concave (a). (*Formica exsecta* species group).	73
72’	In full face view, posterior margin of head with slight concavity, flat, or convex (b).	74

73 (72)	Gaster and front of head shiny. Upper half of head dark brown, thorax with blotches of dark brown, rest of body a yellowish-red.	*Formica ulkei* Emery
73’	Gaster and front of head dull. Head and thorax red.	*Formica opaciventris* Emery

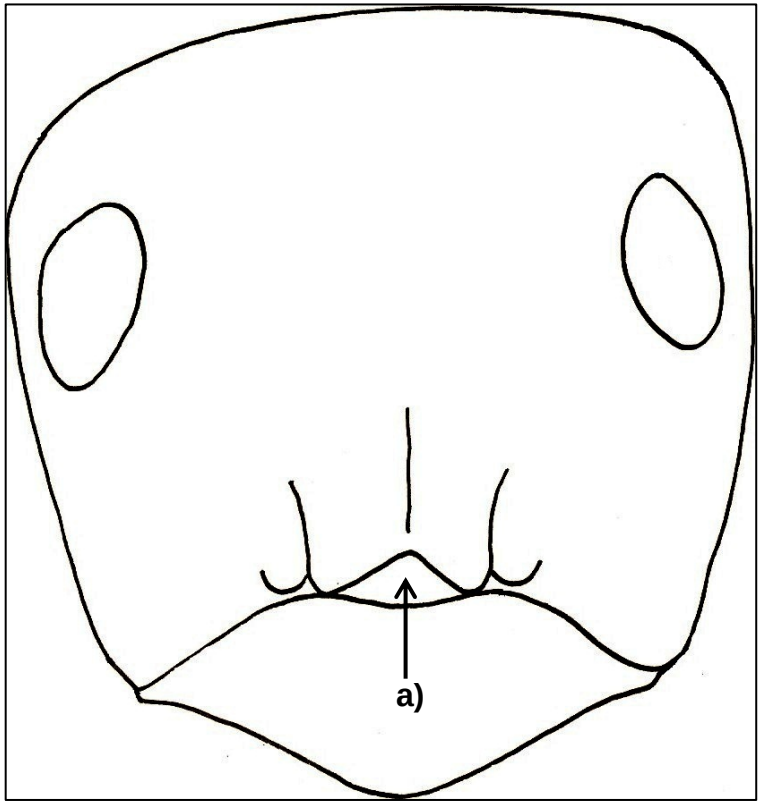
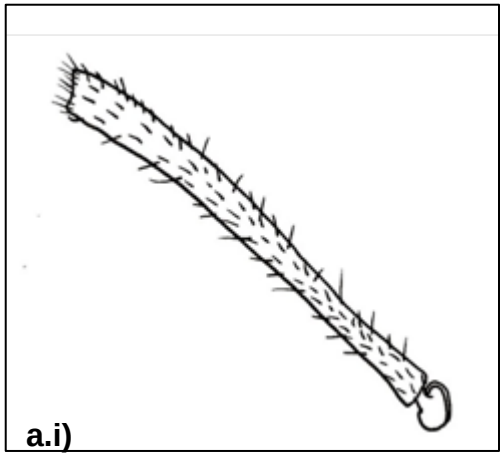
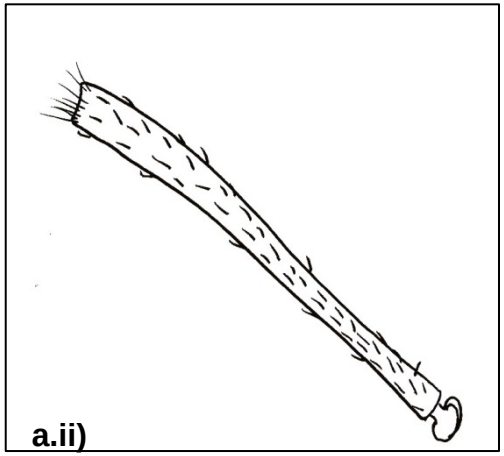


Figure 76.

74 (72)	Bicoloured: head and mesosoma reddish or yellowish-red, or infuscated, but not entirely masking underlying colour; gaster brown or black. Frontal triangle (a) shiny. Workers strongly polymorphic (*Formica rufa* species group).	75
74’	Concolourous or bicoloured. If bicoloured: mesosoma lighter than dark head and gaster. Frontal triangle (a) dull. Workers weakly polymorphic (*Formica fusca* species group).	84





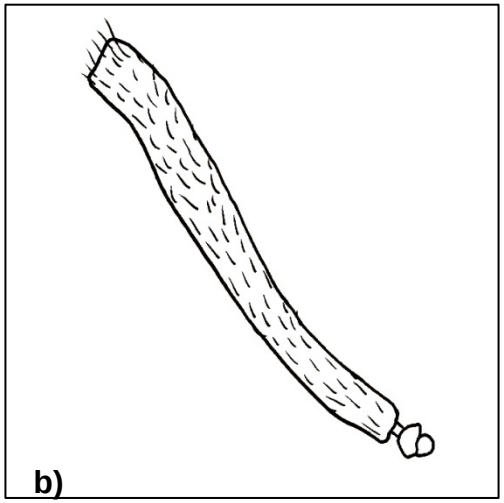


Figure 77.

75 (74)	Scape with erect (a.i) and/or decumbent setae (a.ii). (*Formica oreas* Wheeler)	76
75’	Scape without erect or decumbent setae (except for extreme tip), and typically covered in appressed setae (b).	77

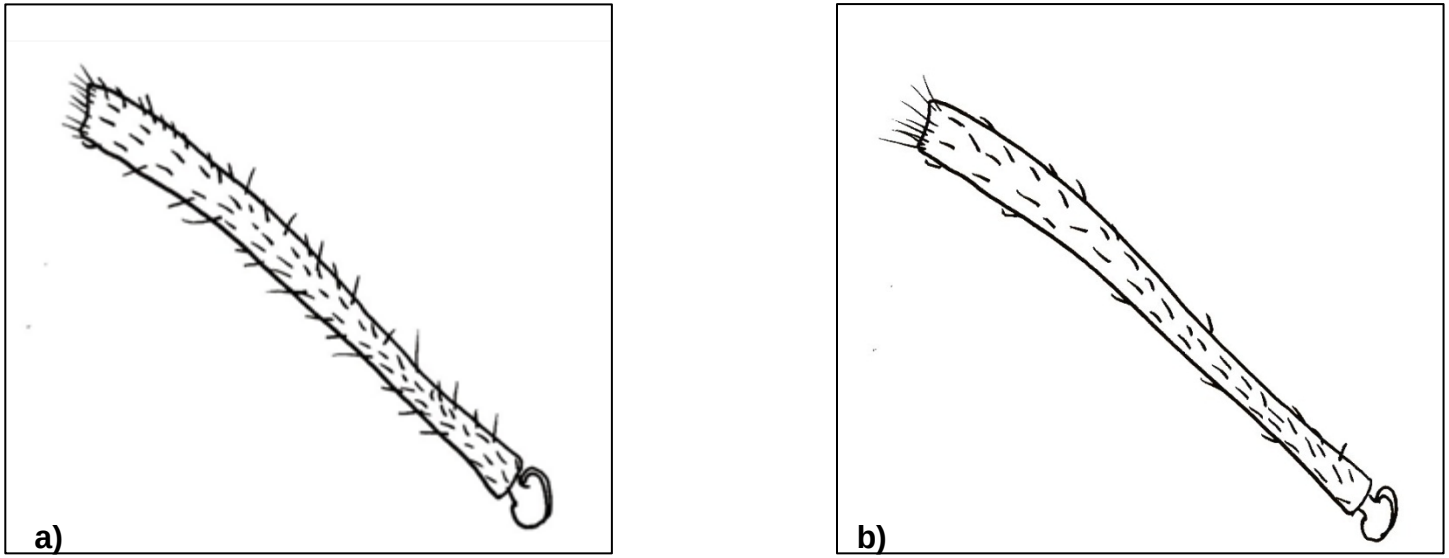


Figure 78.

76 (75)	Scape with erect setae (a). Head and thorax not obviously infuscated.	*Formica oreas* Wheeler
76’	Scape with decumbent and some erect setae (b). Heavily infuscated on head and thorax.	*Formica oreas comptula* Wheeler

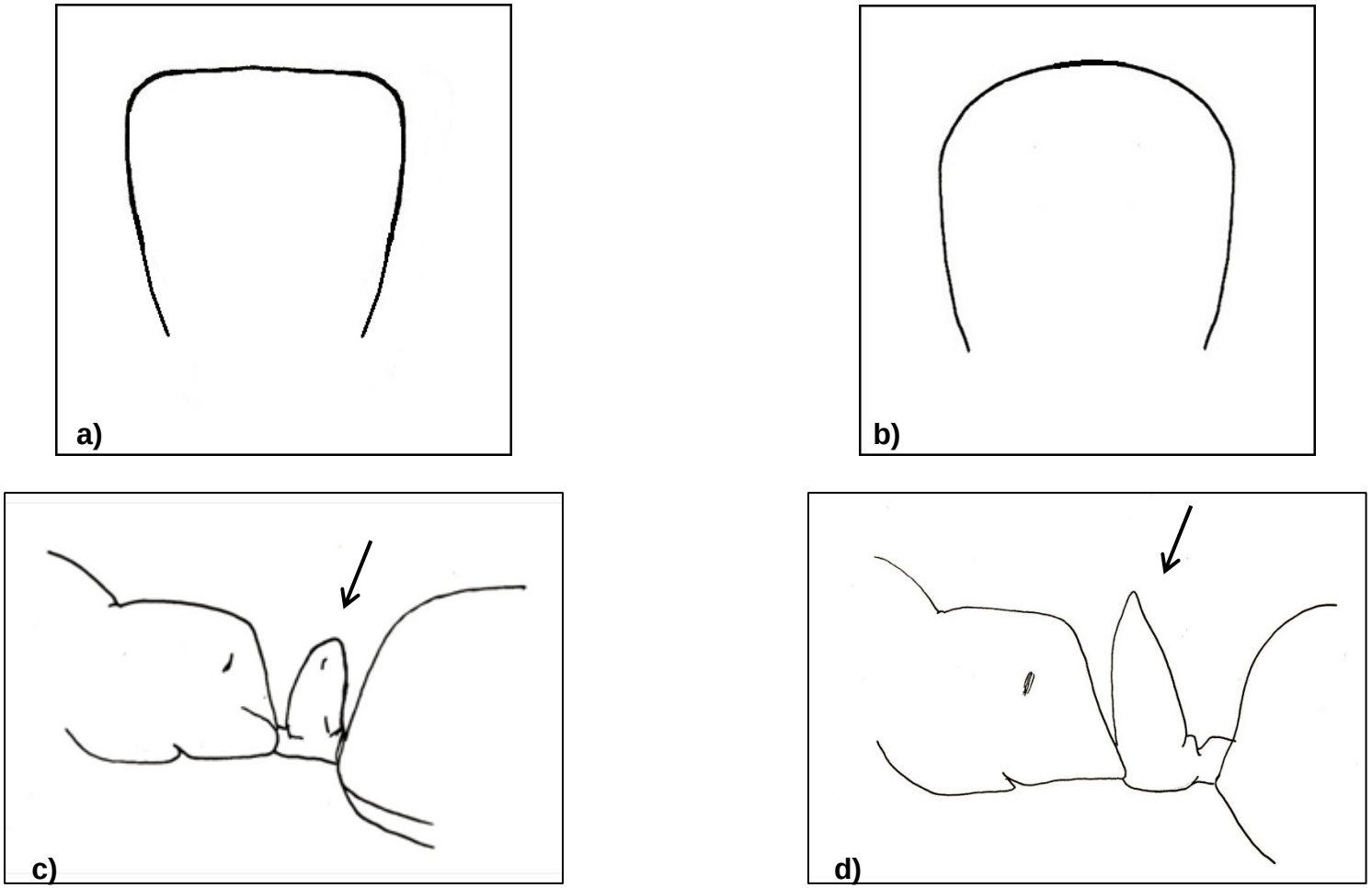


Figure 79.

77 (75)	In posterior view, petiole flat, sometimes slightly concave (a). In profile, apex of petiole distinctly blunt (c).	*Formica dakotensis* Emery
77’	In posterior view, petiole convex or angling upwards (b). In profile, apex of petiole sharp or blunt (d).	78

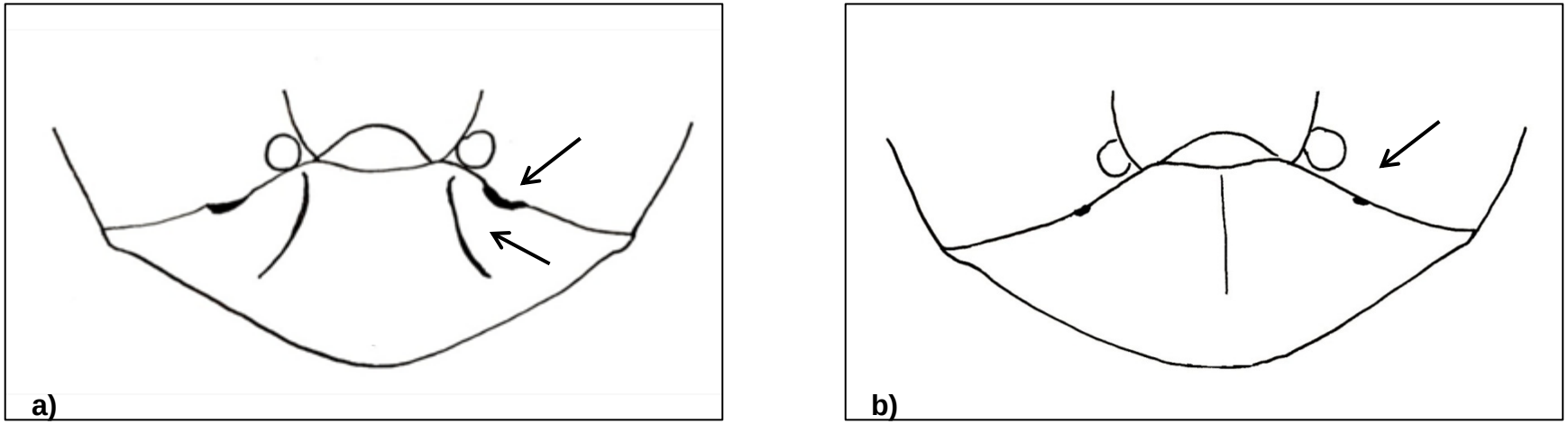


Figure 80.

78(77)	In full face view, medial part of clypeus box-like, with wings of the clypeus abruptly descending to form a deep pit-like clypeal fossa below each antennal socket (a).	79
78’	In full face view, medial part of clypeus not box-like, with wings of clypeus gradually descending to form a shallow clypeal fossa below each antennal socket (b).	80

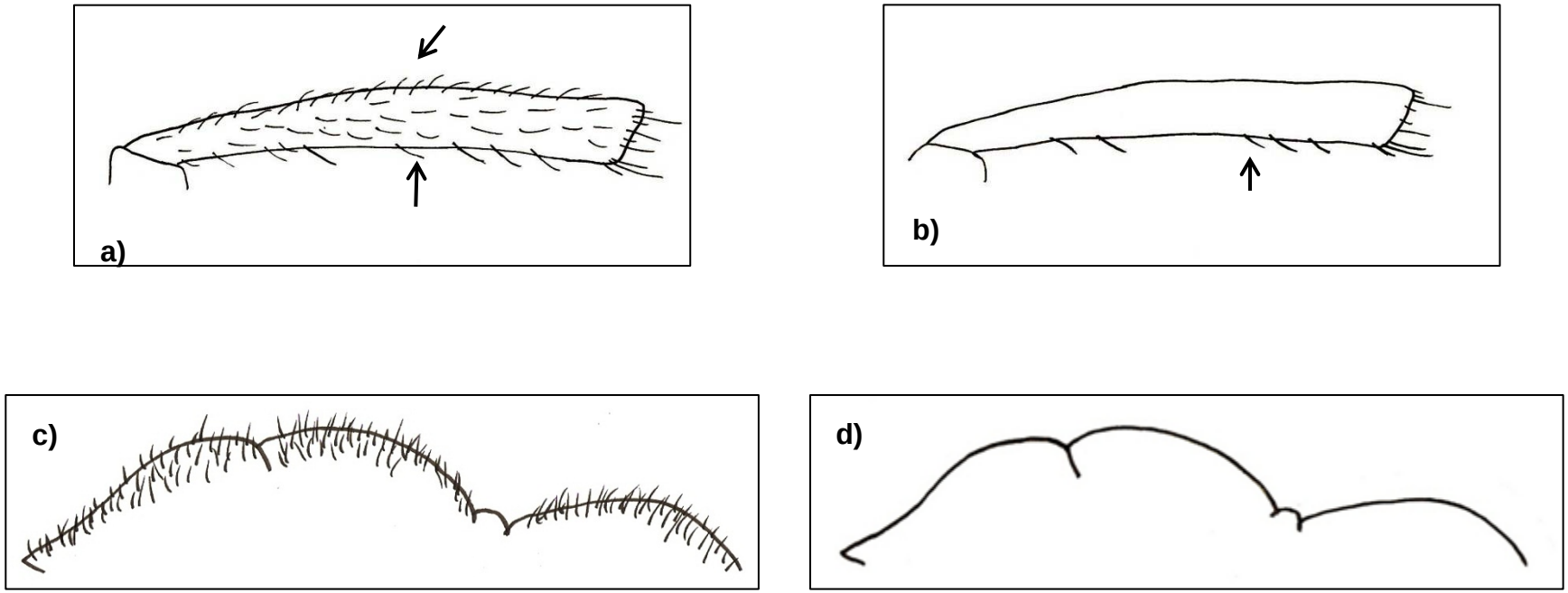


Figure 81.

79 (78)	Middle and hind tibiae with erect setae on all surfaces (a). Erect setae present on dorsal surface of thorax (c).	*Formica obscuriventris* Mayr
79’	Middle and hind tibia without erect setae except on the flexor surface (b). Erect setae absent from dorsal surface of thorax (c).	*Formica fossaceps* Buren

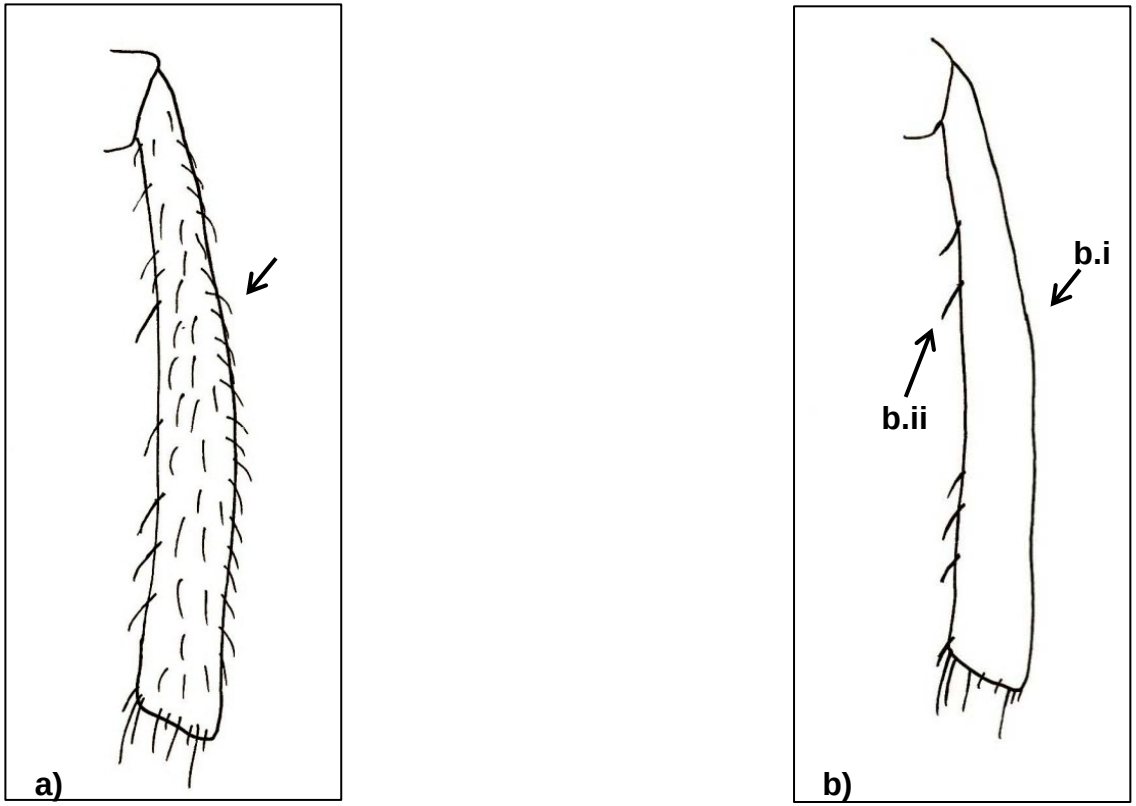


Figure 82.

80 (78)	Erect setae on middle and hind tibiae (a).	81
80’	Erect setae lacking on middle and hind tibiae (b.i), except along flexor surface (b.ii).	82

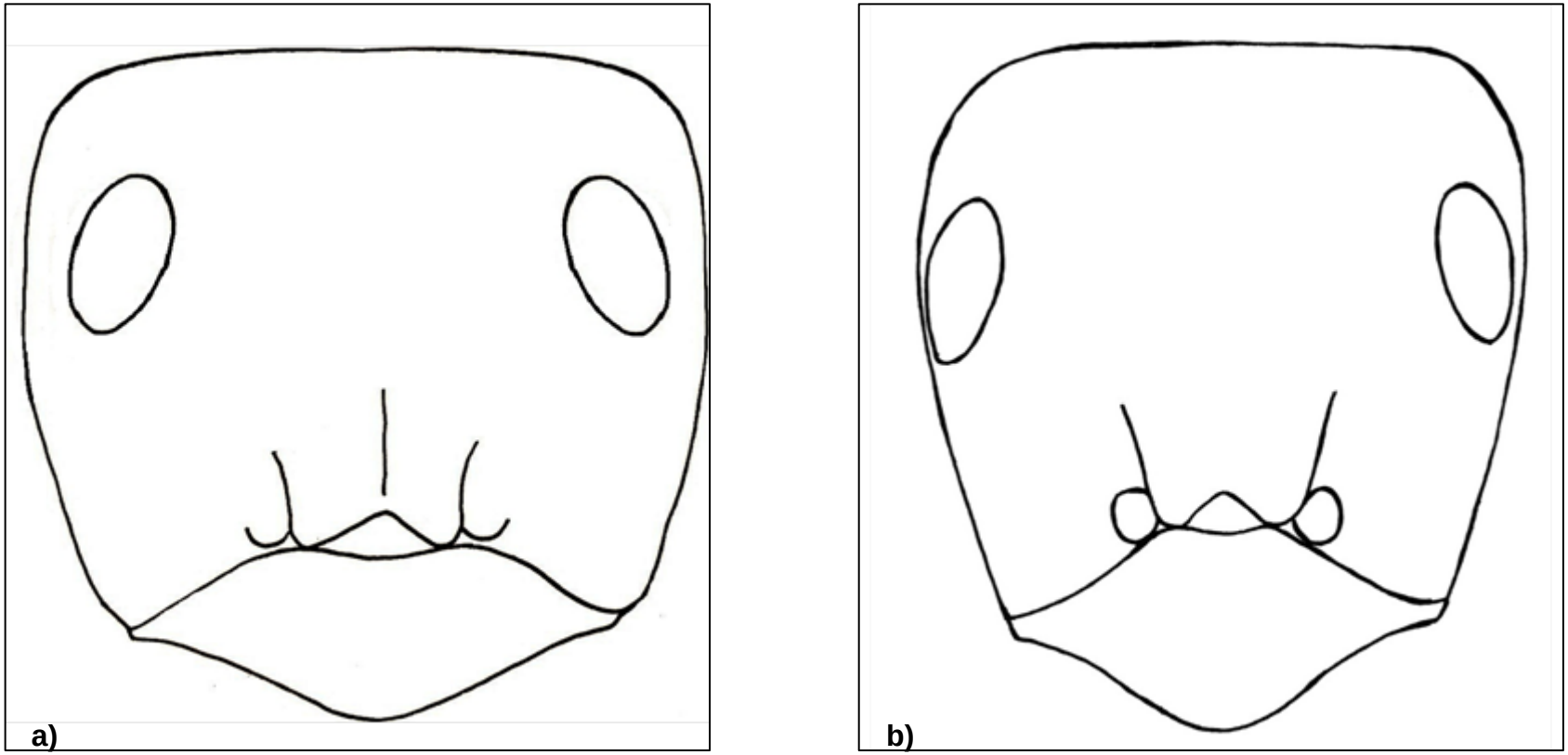


Figure 83.

81 (80)	Head of majors broader (at widest place) than long or as broad as long (a) (not as obvious in minor workers but heads still broad). Not greatly infuscated on head or thorax.	*Formica obscuripes* Forel
81’	Head of majors not as broad as long (b). Heavily infuscated on head and thorax.	*Formica planipilis* Creighton

82 (80)	Clypeus and gena strongly shiny.	*Formica subnitens* Creighton
82’	Clypeus and gena dull.	83

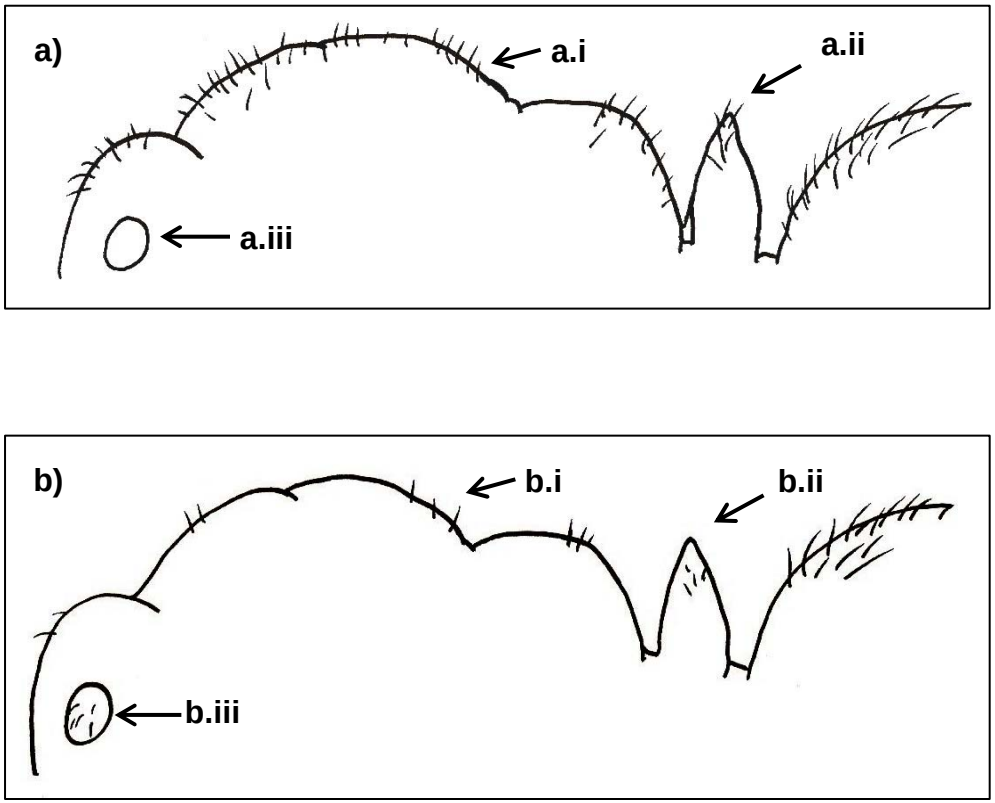


Figure 84.

83 (82)	Erect setae on thorax (a.i) and crest of petiole numerous (a.ii). No erect setae on eyes (a.iii).	*Formica integroides* Wheeler
83’	Erect setae on thorax sparse (b.i), none on crest of petiole (b.ii). Often erect setae on eyes (b.iii).	*Formica ravida* Creighton

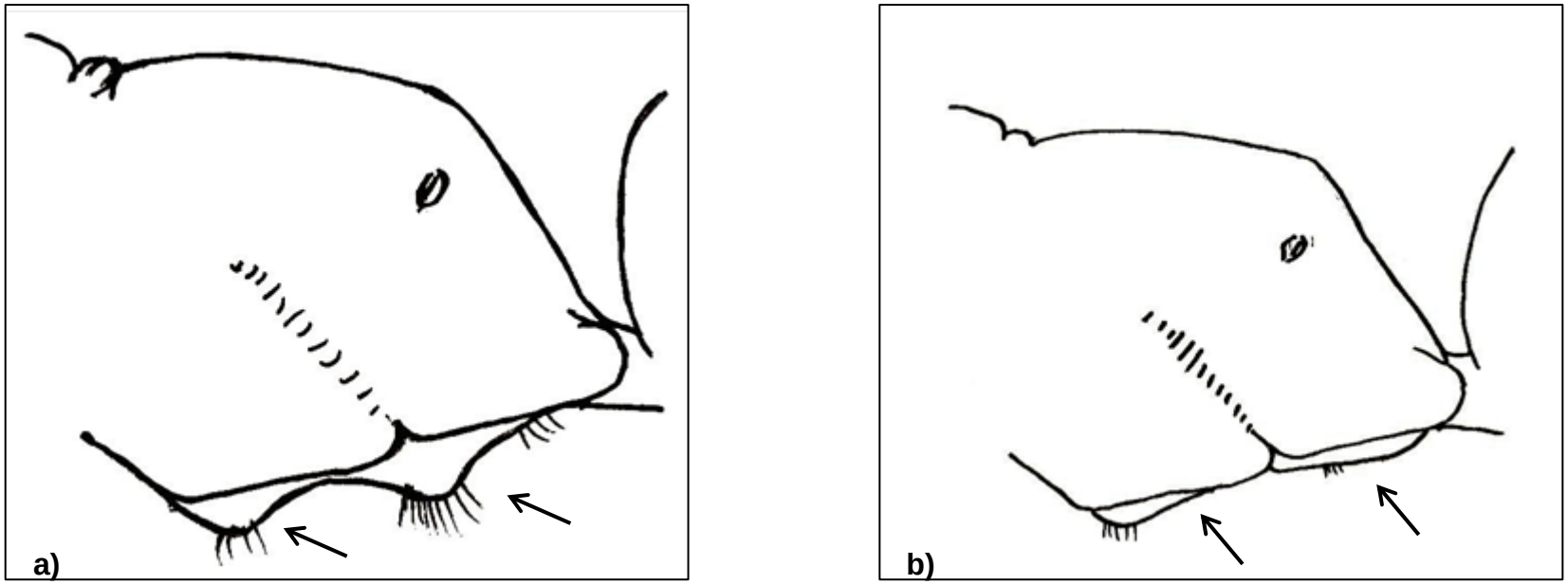


Figure 85.

84 (74)	In lateral view, with legs removed, metasternum with two prominent seta covered lobes (a).	85
84’	In lateral view, with legs removed metasternum without prominent lobes (b).	89

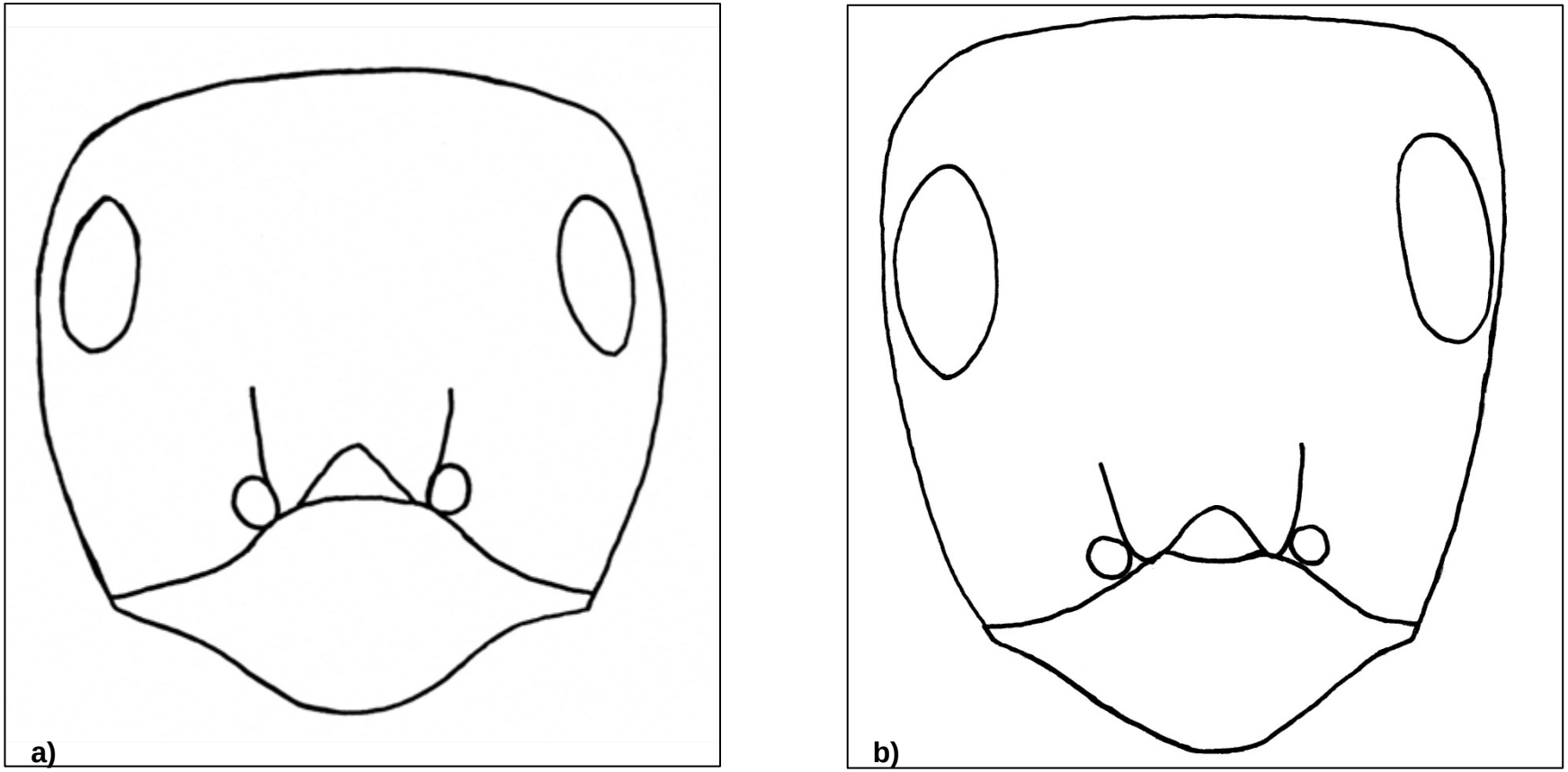


Figure 86.

85 (84)	Eyes small (a), head broader than long (a). Gaster shiny. Highly polymorphic species.	*Formica subpolita* Mayr
85’	Eyes large (b), head longer than broad (b). Gaster feebly shiny or dull. Polymorphic or monomorphic species.	86

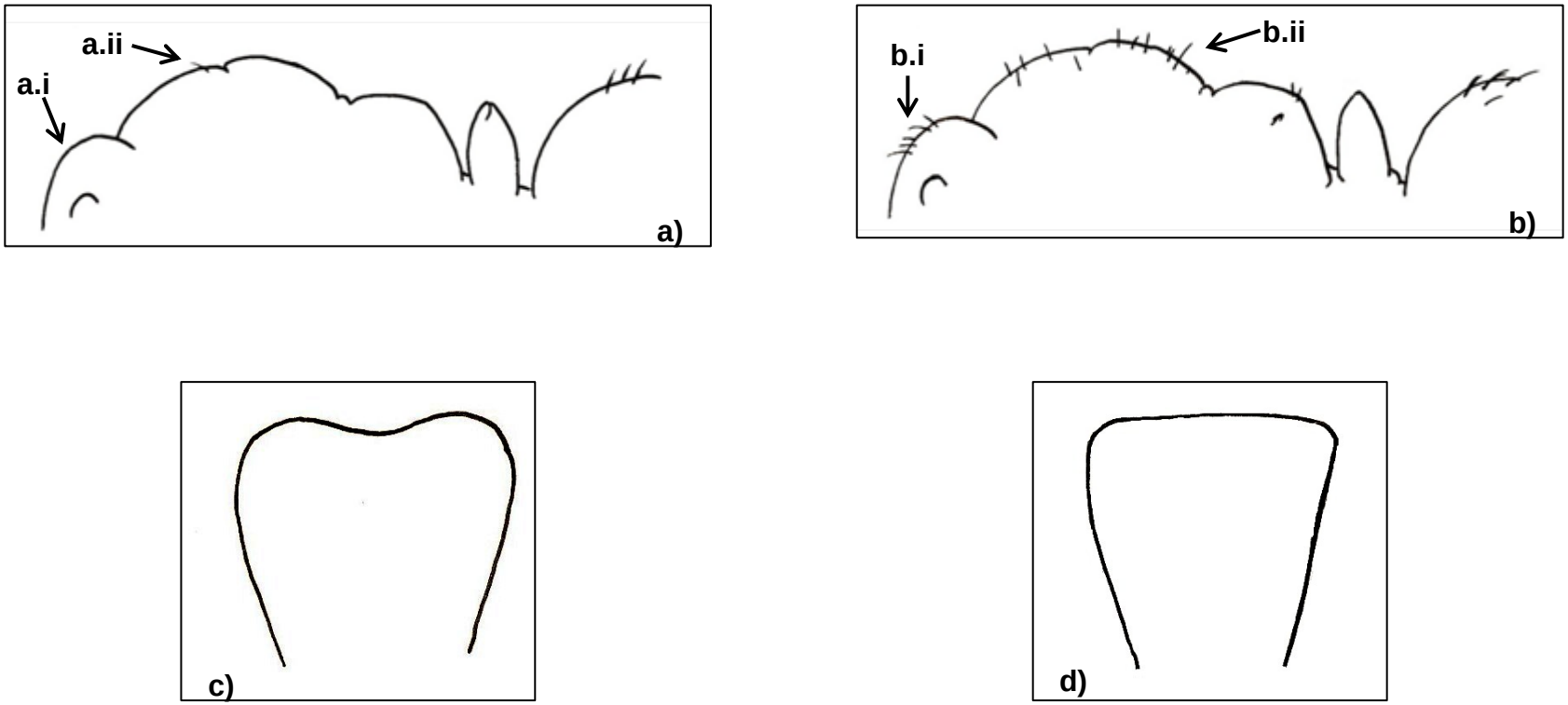


Figure 87.

86 (85)	Erect setae absent on head (a.i). Pronotum may have 1 to 3 small erect setae (a.ii). Petiole in posterior view with a median concavity (c).	*Formica neoclara* Emery
86’	Erect setae present on head (b.i) and pronotum (b.ii). Petiole in posterior view without a concavity (d).	87

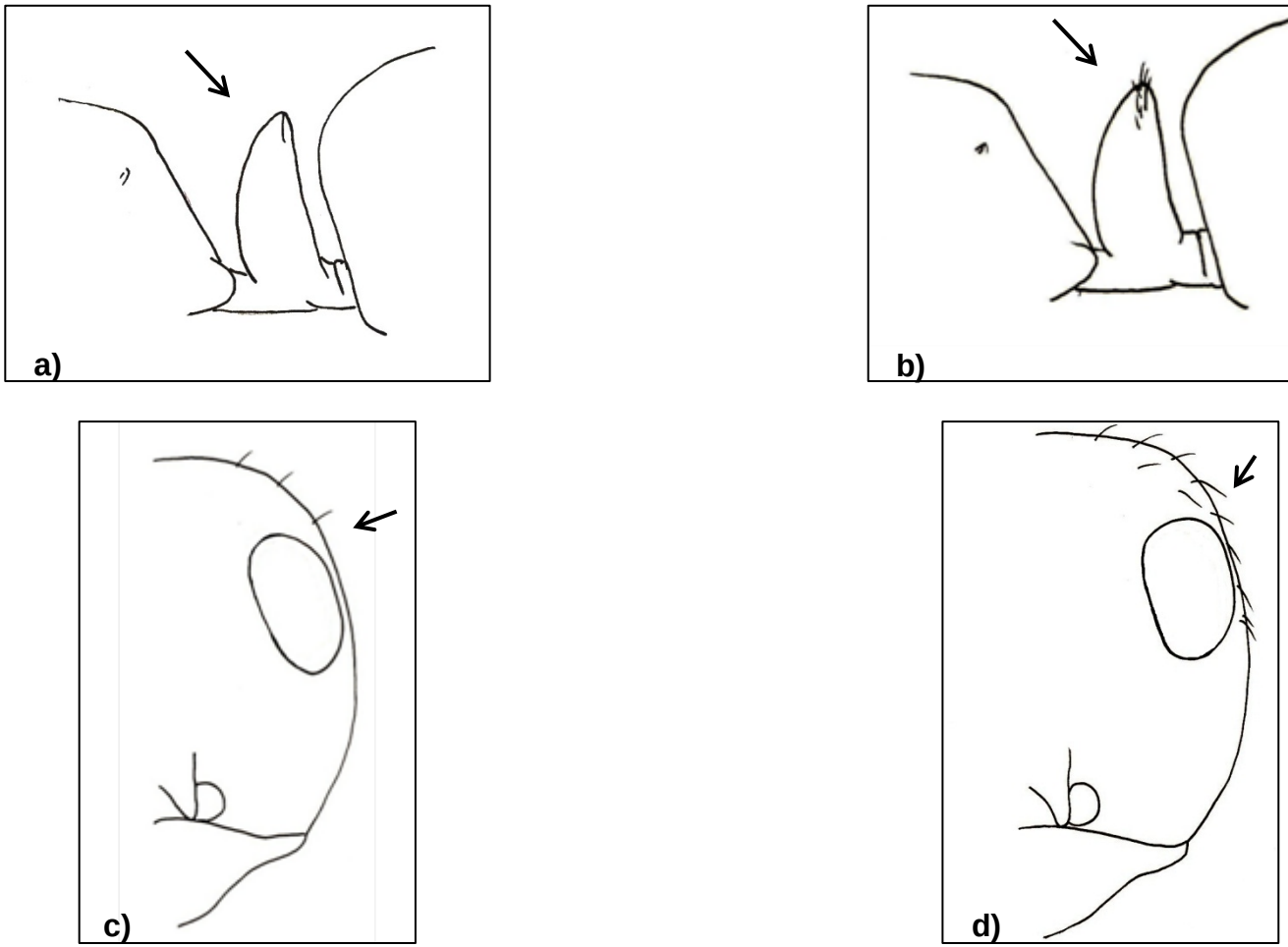


Figure 88.

87 (86)	Crest of petiole without erect setae (a). Erect setae sparse on occipital margin and not extending past posterior margin of eye (c).	*Formica altipetens* Wheeler
87’	Crest of petiole with erect setae (b). Erect setae dense on occipital margin and extending to, or past posterior margin of eye (d).	88

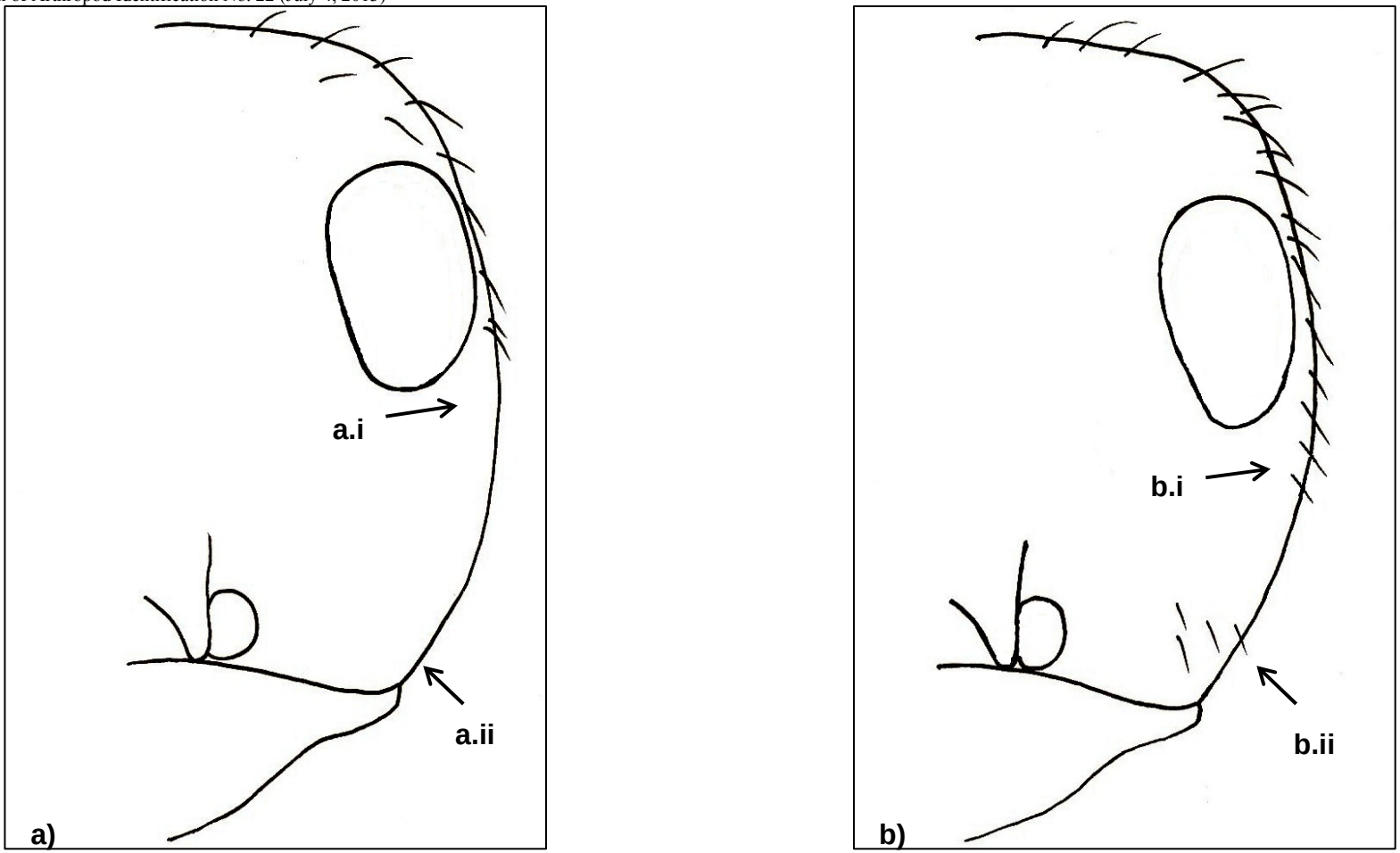
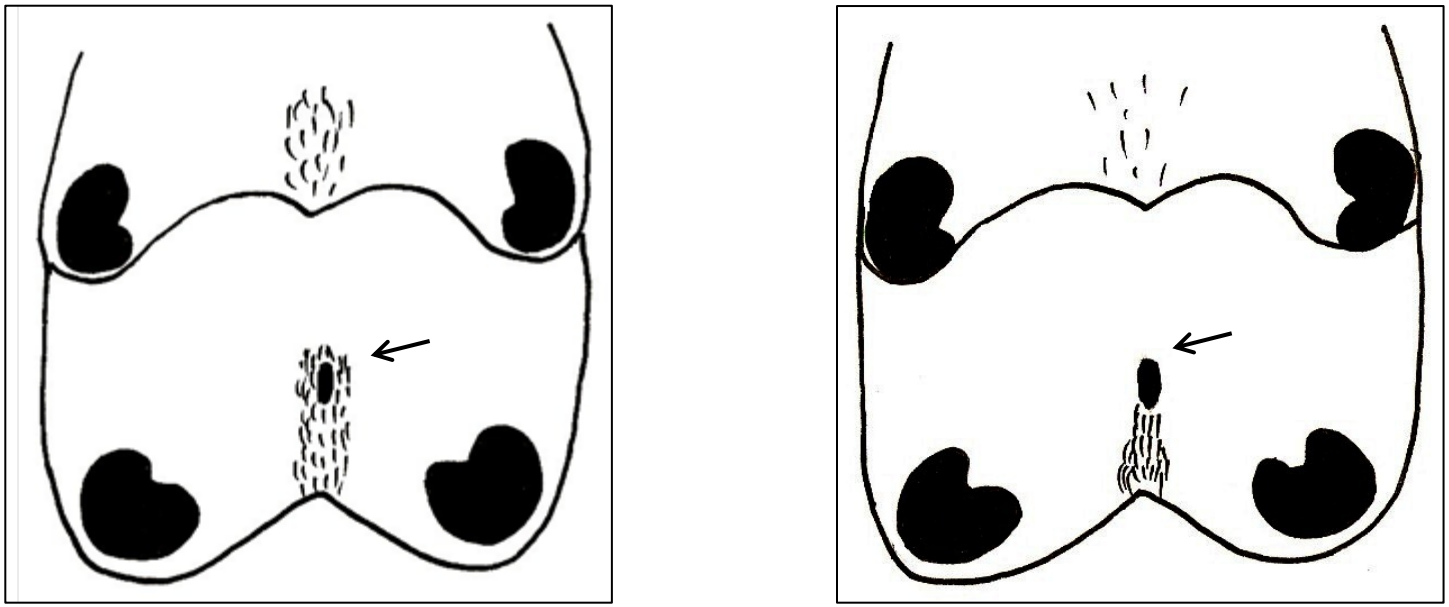


Figure 89.

88 (87)	Erect setae extend along ventral border of eye (a.i). Erect setae on side of head sparse (a). Gena without erect setae (a.ii).	*Formica montana* Wheeler
88’	Erect setae extend past ventral border of eye (b.i). Erect setae on side of head normal to dense (b). Gena with erect setae (b.ii).	*Formica canadensis* Santschi



a) b)

Figure 90.

89(84)	Setae surrounding spinasternal cavity (area between metathoracic coxae, requires removal of legs to see) (a). First gastric tergite with few erect setae (maximum of 10, excluding posterior row).	90
89’	Setae lacking, or restricted to an area posterior to the spinasternal cavity (area between metathoracic coxae, requires removal of legs to see) (b). First gastric tergite often with abundant erect setae (usually more than 10, excluding posterior row, unless setae have been abraded, which is common).	91

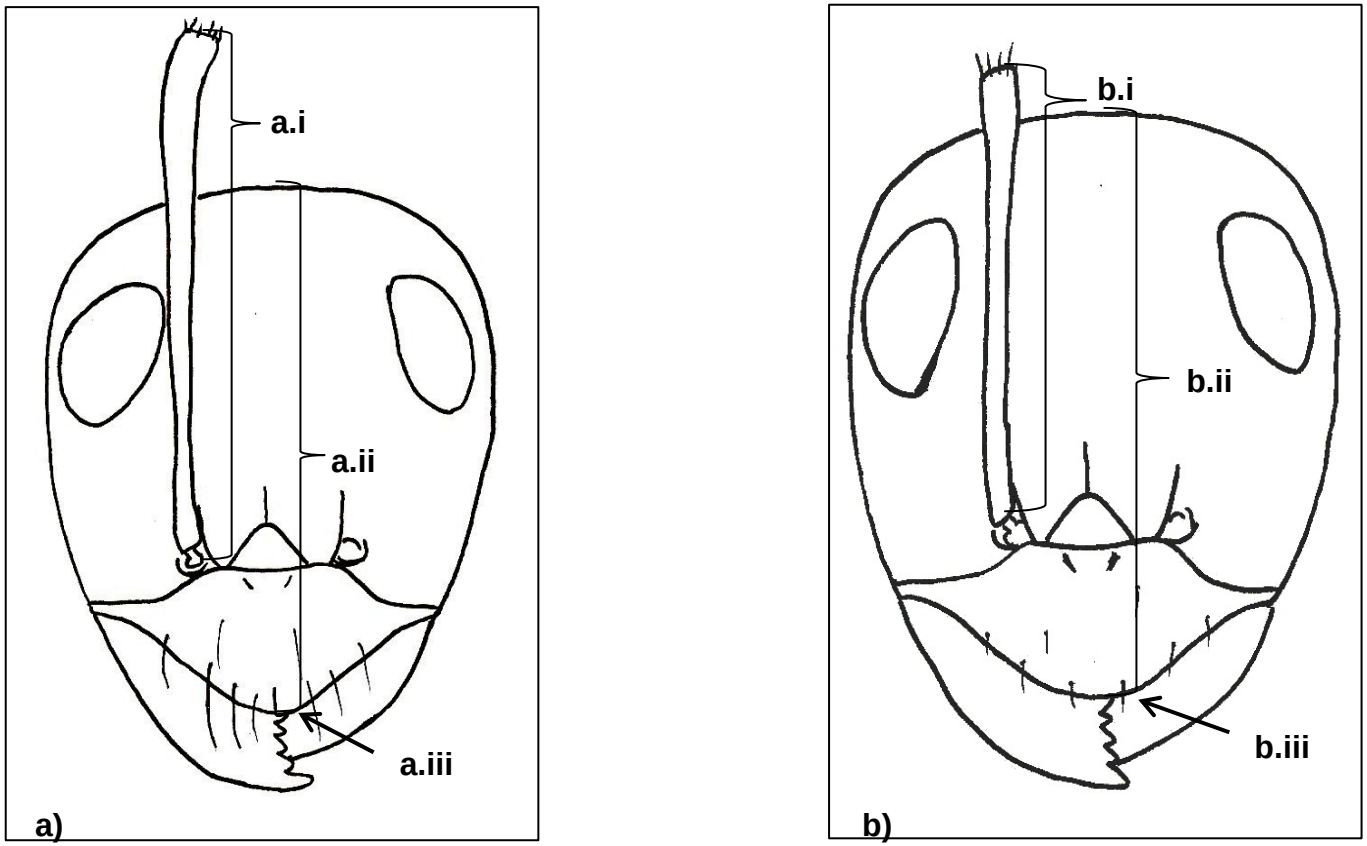


Figure 91.

90(89)	Scape (a.i) as long or longer than head (a.ii). Margin of clypeus relatively angulate (a.iii).	*Formica accreta* Franceour
90’	Scape (b.i) shorter than head (b.ii). Margin of clypeus broadly convex (b.iii).	*Formica fusca* Linnaeus

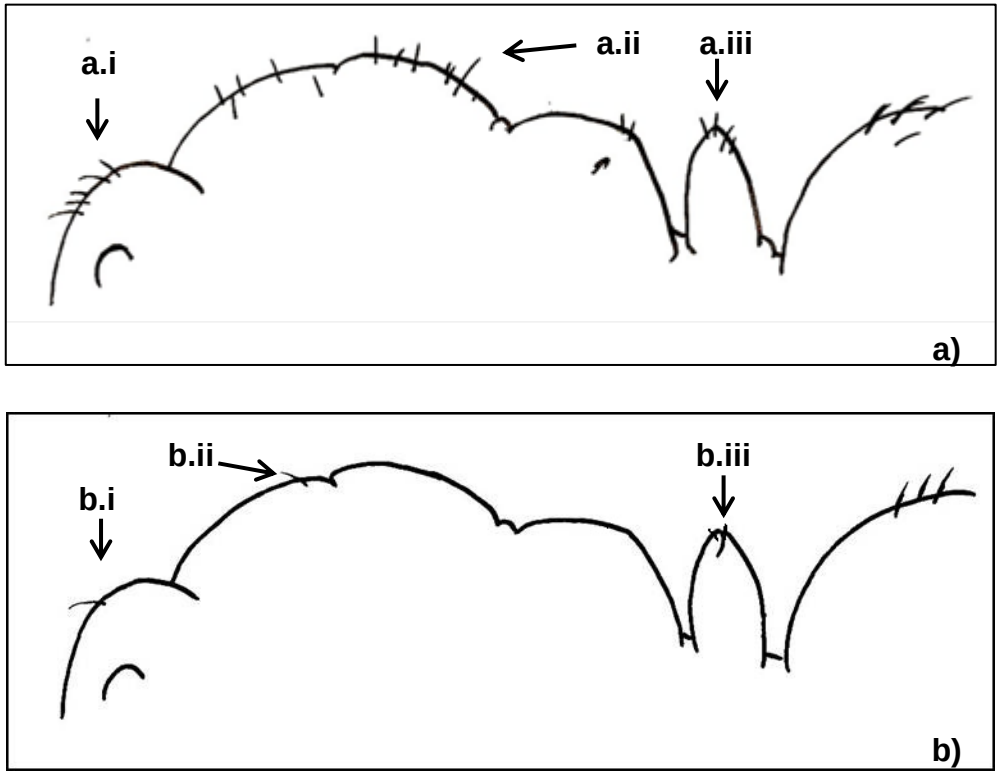


Figure 92.

91(89)	Numerous erect setae on dorsal surface of head (a.i), dorsal surface of mesosoma (a.ii), and dorsal margin of petiole (a.iii)	*Formica hewitti* Wheeler
91’	Three or less erect setae on dorsal surface of head (b.i), dorsal surface of mesosoma (b.ii), and sometimes one or two erect setae on dorsal margin of petiole (b.iii).	92

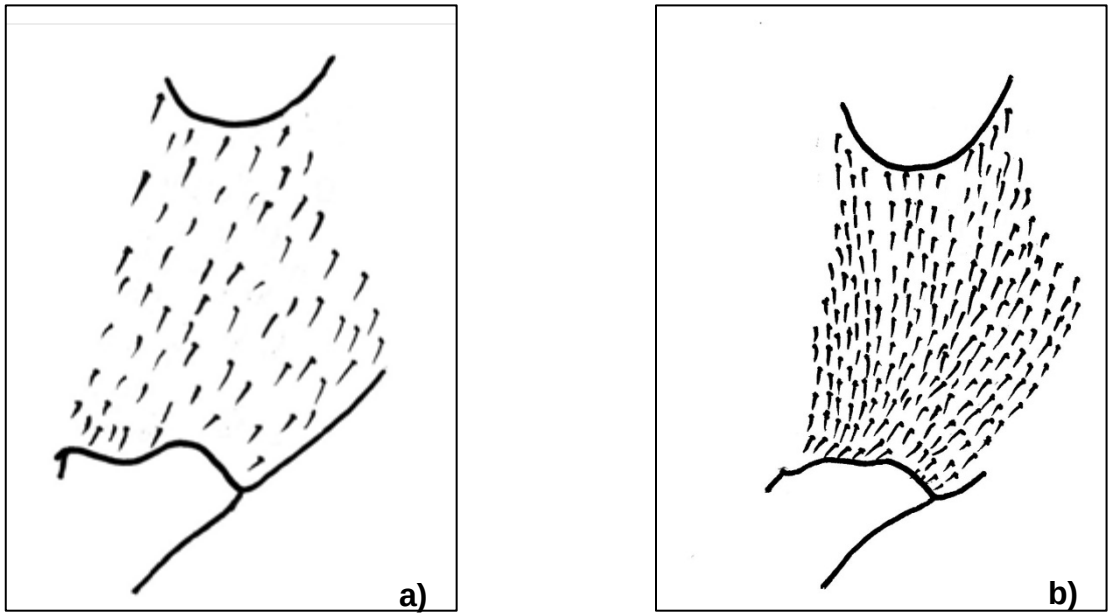


Figure 93.

92(91)	Bicoloured, with thorax yellowish red, head and gaster reddish-black; small minor workers are sometimes completely dark- brown. Pubescence sparse on gena (a) and thorax.	*Formica neorufibarbis* Emery
92’	Concolourous. Pubescence dense on gena (b) and thorax.	93

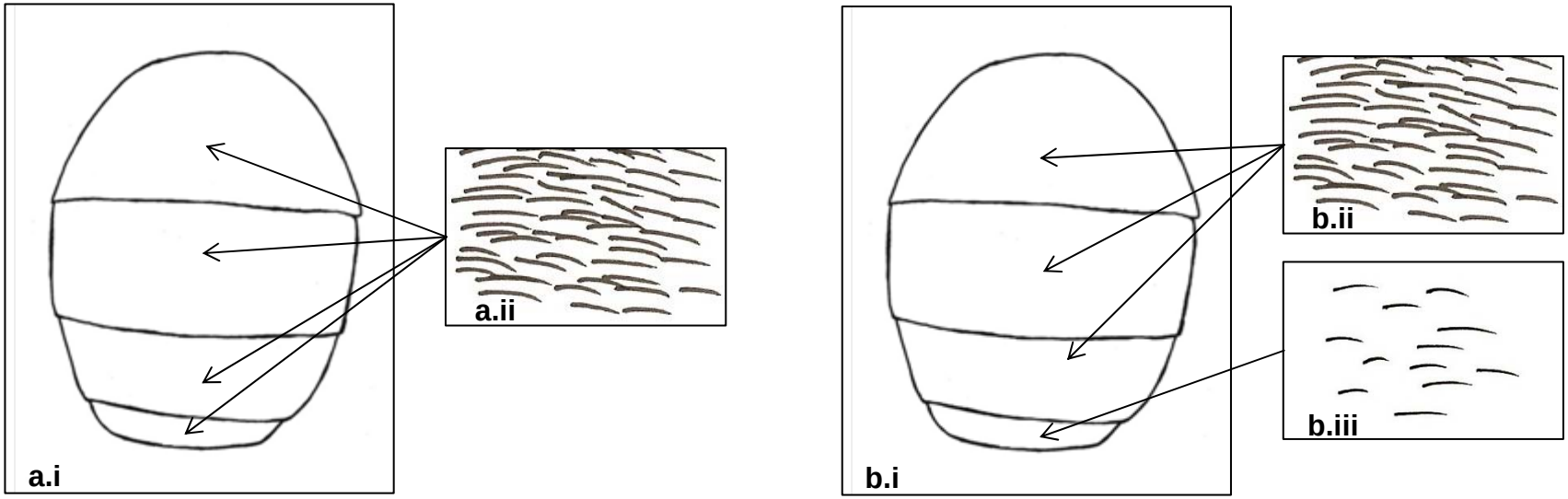


Figure 94.

93(92)	In dorsal view, gaster (a.i) with pubescence dense on all four gastric tergites (a.ii).	*Formica argentea* Wheeler
93’	In dorsal view, gaster (b.i) with pubescence on first three tergites variable in density (b.ii), sparse on fourth gastric tergite (b.iii).	94

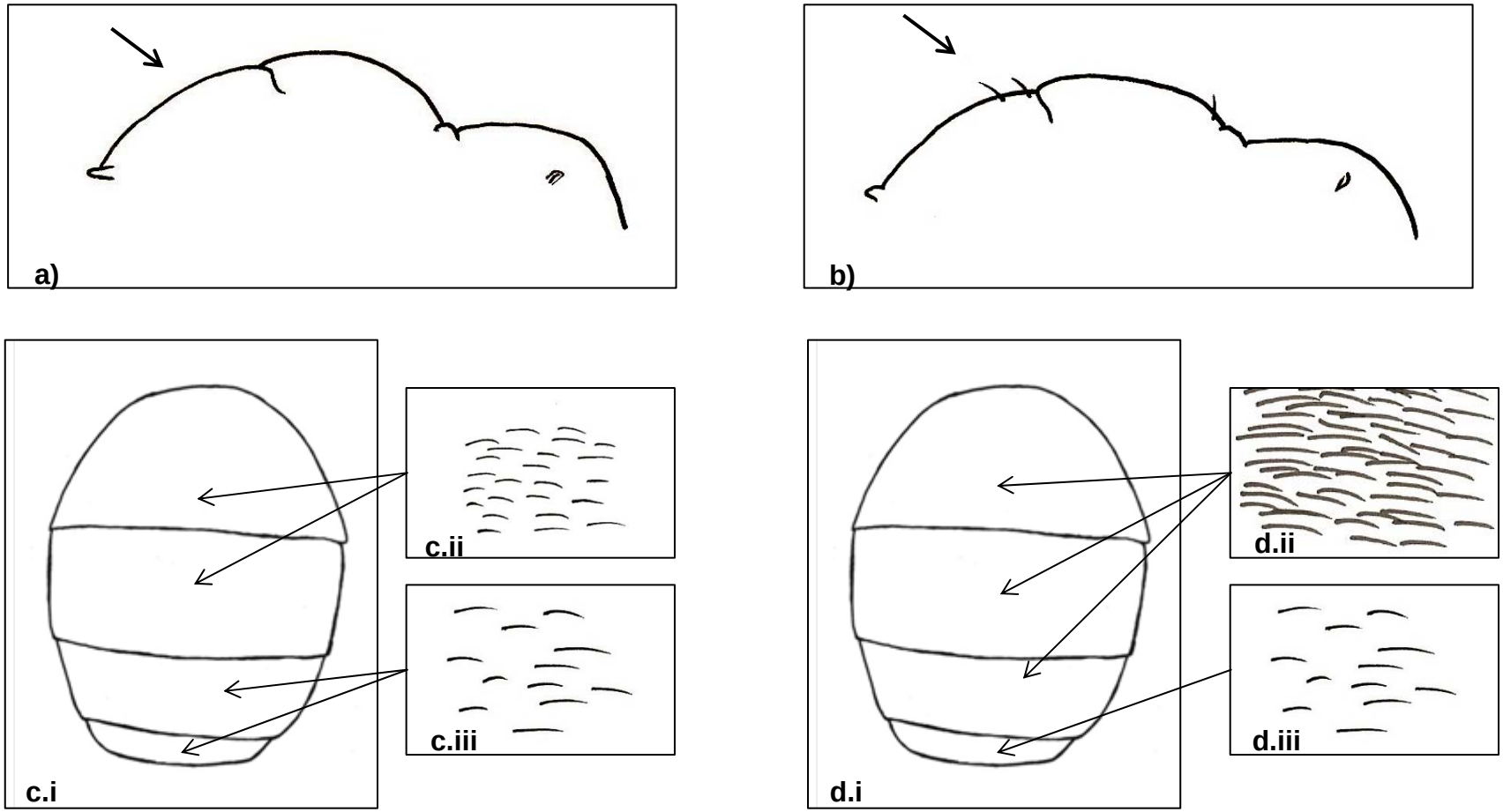


Figure 95.

94(93)	Promesonotum without erect setae (a). In dorsal view, gaster (c.i) with first two dorsal gastric tergites with normal density of pubescence (c.ii), sparse on the rest (c.iii).	*Formica glacialis* Wheeler
94’	Promesonotum with erect setae (a). In dorsal view, gaster (d.i) with gastric pubescence moderately dense on first three dorsal gastric tergites (d.ii), sparse on fourth (d.iii).	*Formica podzolica* Francoeur

Acknowledgments

We would especially like to thank Robert Higgins, not only for specimens, but for an extremely helpful and thorough review of this manuscript. For comments on earlier drafts of the key, we thank Tyler Cobb, Jeffery Newton, and John Spence. Thank you to all the following for help in the field, with museum specimens, and other assistance on this project: Melissa Baron, Colin Bergeron, Matthias Buck, Alfred Buschinger, Ralph Cartar, Carl Conradi, Sean Coogan, Gordon Court, Brian Fisher, Andre Francoeur, Ken Fry, Alicia Glasier, Linda Glasier, Christie Kneteman, Caroline LeCourtois, Darin Molinaro, Danny Shpeley, Felix Sperling, Sonya Odsen, John Swann, Jeff Proudfoot, Mike Yang, and the ants themselves. Thank you to Brian Fisher and www.antweb.org, for allowing us to link the key to their images to help improve identification of specimens.

Funding for this work was provided by Alberta Conservation Association (ACA) Grant in Biodiversity and the Development Initiatives Program via Alberta Sports, Recreation, Parks, and Wildlife Foundation both of which were given to James R.N. Glasier.

References

Bolton, B. 1994. Identification Guide to the Ant Genera of the World. Harvard University Press: Cambridge, Massachusetts, USA. 222 pp.

Bolton, B. 1995. A new general catalogue of the ants of the world. Harvard University Press, Cambridge, Massachusetts, USA. 504 pp.

Briese, D. 1982. The affects of ants on the soil of a semi-arid saltbush habitat. Insectes Sociaux **29**: 375–386.

Buschinger, A. 1979. *Doronomyrmex pocahontas*, n. sp., a parasitic ant from Alberta, Canada (Hym. Formicidae). Insectes Sociaux **26**: 216–222.

Buschinger, A. 1983. *Leptothorax faberi* n. sp., an apparently parasitic ant from Jasper National Park Canada. (Hymenoptera: Formicidae). Psyche **89**: 197–209.

Buschinger, A. and Schultz, A. 2008. *Lepthothorax athabasca* sp. n. (Hymenoptera: Formicidae) from Alberta, Canada, an ant with an apparently restricted range. Myrmecological News **11**: 243–248.

Buschinger, A. and Heinze, J. 1993. *Doronomyrmex pochahontas*: not a workerless parasite but still an enigmatic taxon (Hymenoptera: Formicidae). Insectes Sociaux **40**: 423–432.

Buschinger, A., Schumann, R.D., and Heinze, J. 1994. First record of the guest ant *Formicoxenus quebecensis* Francoeur from western Canada (Hymenoptera: Formicidae). Psyche **101**: 53–57.

Clark, W.H. and Blom, P.E. 2007. Ants of the Idaho National Laboratory. Sociobiology **49**: 1–115.

Creighton, W.S. 1950. The ants of North America. Bulletin of the Museum of Comparative Zoology **104**: 1–585.

Fisher, B.L. and S.P. Cover. 2007. Ants of North America A Guide to the Genera. University of California Press, Los Angeles, California, USA. 194 pp.

Folgarait, P. 1998. Ant biodiversity and its relationship to ecosystem functioning: a review. Biodiversity and Conservation **7**: 1221–1244.

Francoeur, A. 1973. Révision taxonomique des espèces néarctiques du groupe *Fusca*, genre *Formica* (Formicidae, Hymenoptera). Mémoires de la Société Entomologique du Québec **3**: 1–316.

Francoeur, A. 1986. Deux nouvelles fourmis Neartiques: *Leptothorax retractus* et *L. sphagnicolus* (Formicidae, Hymenoptera). The Canadian Entomologist **118**: 1151–1164.

Francoeur, A. and Buschinger, A. 1985. Biosystématique de la tribu Leptothoracini (Formicidae, Hymenoptera) 1. Le genere *Formicoxenus* dans la région Holarctique. Naturaliste Canadien **112**: 343–403.

Glasier, J.R.N. 2012. Community ecology of ants (Hymenoptera: Formicidae) in the central sand hills of Alberta, and a key to the ants of Alberta. M.Sc. Thesis. University of Alberta: Canada. 199 pp.

Gregg, R.E. 1972. The northward distribution of ants in North America. The Canadian Entomologist **104**: 1073–1091.

Hansen, L.D. and Klotz, J.H. 2005. The Carpenter Ants of the United States and Canada. Cornell University Press, Ithaca, New York, USA. 204 pp.

Heinze, J. 1989. *Leptothorax wilsoni* n.sp., a new parasitic ant from eastern North America (Hymenoptera: Formicidae). Psyche **96**: 49–61.

Heinze, J., Trunzer, B., and Ortius, D. 1995. A second host species for the inquiline ant *Leptothorax wilsoni*. Psyche **102**: 74–77.

Heron, J. 2005. Ants of the south Okanagan grasslands, British Columbia. Arthropods of Canadian Grasslands **11**: 17–22.

Hölldobler, B. and Wilson, E.O. 1990. The Ants. The Belknap Press of Harvard University Press, Cambridge, Massachusetts, USA. 732 pp.

Howe, M.A., Knight, G.T., and Clee, C. 2010. The importance of coastal dunes for terrestrial invertebrates in Wales and the UK, with particular reference to aculeate Hymenoptera (bees, wasps & ants). Journal of Coast Conservation **14**: 91–102.

Jones, C.G., Lawton, J.H., and Shachak, M. 1994. Organisms as ecosystem engineers. Oikos **69**: 373–386.

Klotz, J., Hansen, L., Pospischil, R., and Rust, M. 2008. Urban Ants of North America and Europe. Cornell University Press, Ithaca, New York, USA. 196 pp.

Mackay, W. 2000. A review of the New World ants of the subgenus *Myrafant*, subgenus *Leptothorax* (Hymenoptera: Formicidae). Sociobiology **36**: 265–444.

Mackay, W. and Mackay E. 2002. The ants of New Mexico (Hymenoptera: Formicidae) The Edwin Mellen Press, Lewiston, New York, USA. 398 pp.

Mackay, W.P. and Buschinger, A. 2002. A new species of the ant genus *Leptothorax* (subgenus *Myrafant*) from Alberta, Canada. Sociobiology **20**: 539–546.

Mackay, W.P. 1993. A review of the New World ants of the genus *Dolichoderus* (Hymenoptera: Formicidae). Sociobiology **22**: 1–148.

Naumann, K., Preston, W.P., and Ayre. G.L. 1999. An annotated checklist of the ants (Hymenoptera: Formicidae) of British Columbia. Journal of the Entomological Society of British Columbia **96**: 29–68.

Newton, J. S., Glasier, J., Maw, H.E.L., Proctor, H.C., and Foottit, R.G. 2011. Ants and subterranean Sternorrhyncha in a native grassland in east-central Alberta. The Canadian Entomologist **143**: 518–523.

Perry, J.C., Mondor, E.B., and Addicott, J.F. 2004. An indirect mutualism: ants deter seed predators from ovipositing on yucca fruit. Canadian Journal of Zoology **82**: 823–827.

Savolainen, R. and Deslippe, R.J. 2001. Facultative and obligate slave making in *Formica* ants. Naturwissenschaften **88**: 347–350.

Sharplin, J. 1966. An annotated list of the Formicidae (Hymenoptera) of central and southern Alberta. Quaestiones Entomologicae **2**: 243–253.

Torre-Bueno, J.R. de la, Nichols, S.W., Tulloch, G.S., and Schuh, R.T. 1989. The Torre-Bueno glossary of entomology. New York, N.Y., USA: New York Entomological Society in cooperation with the American Museum of Natural History. 821 pp.

Trager, J.C., Macown, J.A., and Trager, M.D. 2007. Revision of the Nearctic endemic group *Formica pallidelfulva*. pp. 610–636, in Snelling, R.R., Fisher, B.L., and Ward, P.S. (eds), Advances in ant systematics (Hymenoptera: Formicidae): homage to E.O. Wilson - 50 years of contributions. Memoirs of the American Entomological Institute, **80**: 1–690.

Wheeler, W.M. 1905. New species of *Formica*. Bulletin of the American Museum of Natural History **21**: 267–274.

Wheeler, W.M. 1913. A revision of the ants of the genus *Formica* (Linnaeus) Mayr. Bulletin of the Museum of Comparative Zoology of Harvard College **53**: 379–565.

Wheeler, G.C. and Wheeler, J. 1963. The Ants of North Dakota. University of North Dakota Press, Grand Forks, North Dakota, USA. 326 pp.

Wheeler, G.C. and Wheeler, J. 1977. North Dakota Ants Updated. Desert Research Institute, University of Nevada System, Reno, Nevada, USA. 27 pp.

Wheeler, G.C. and Wheeler, J. 1986. The Ants of Nevada. Natural History Museum of Los Angeles County, Los Angeles, California, USA. 138 pp.

Wheeler, G.C. and Wheeler, J. 1988. A checklist of the ants of Montana. Psyche **95**: 101–114

Wilson, E.O. 1955. A monographic revision of the ant genus *Lasius*. Bulletin of the Museum of Comparative Zoology **113**: 1–199.

Wu, J. and Wong, H.R. 1987. Colonization of lodgepole pine stumps by ants (Hymenoptera: Formicidae). The Canadian Entomologist **119**: 397–398.

Yensen, N.P., Clark, W.H., and Francoeur, A. 1977. A checklist of Idaho ants (Hymenoptera: Formicidae). Pan-Pacific Entomologist **53**: 181–187.