IDENTIFICATION GUIDE TO THE ANT SUBFAMILY OF BORNEO

by
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Introduction

In the present situation the need to conserve the forest everywhere on earth has become the most urgent agenda. Reasons related to it include the loss of biodiversity, the loss of potential genetic resources, the lesser carbon sink available. Countries such as Malaysia endowed with vast areas of forest are aware of the problems and as such have still maintained a fairly high percentage of forest coverage, in the region of 50-70%. Being a fast developing nation however, the financial demand is now greater than ever. As timber is much in demand by the world, the forest offers a lucrative income-generating source. Also by clearing forests, lands are made available for other uses such as to grow plantation crops : cocoa, oil palm, rubber, which again are income-generating. The cleared land also provides space for more settlements, to cater for the growing population.

The balance between getting enough income from the forest - thus the need to clear forests, and the need to conserve it has lead to many effort to study effects of forest clearing and reforestation. In between the so many work carried out there rises a need to find a tool to measure how disturbed a forest is so that the appropriate remedy can be carried out. The tools which include bioindicators are now being studied. The aim of this lecture is to bring to focus the use of an insect group which we believe has a good potential to be used as a bioindicator of the forest ecosystem - the ants.

Ants are one of the most abundant and diverse animal groups in tropical ecosystems (Stork, 1987, 1991), and they function at many levels in these ecosystems - as predators and prey, as detritivores, mutualists, and herbivores (Holldobler and Wilson, 1990). Thus, ants have the potential to yield more meaningful biodiversity data than many other organisms, such as plants, birds, and butterflies. Moreover, since most species have stationary, perennial nests with fairly restricted foraging ranges, ants have a potential role as indicators of environmental change. Because of the potential usefulness, inventory of ants has been viewed as an important task in tropical biodiversity and conservation studies (Agosti *et al*., 2000).

The most difficult part of ant inventory in tropical region is identification process. Inventory data are usually analyzed by relying on the presence or absence of species. However, identification of tropical ant specimens to species will be very difficult or impossible, because most groups of the ants have yet to be studied in detail. This difficulty makes the recognition of morphospecies a necessary part of inventory studies for ants (Agosti *et al*., 2000).

The identifying ants to genus-level are not impossible, because excellent identification-key to ant genera of the all parts of the world is available in Bolton (1994). Thus, for sorting ant specimens into morphospecies, they should be identified to genus (i.e., Ant species 1 and species 2 to *Aenictus* sp.

1 and *Camponotus* sp. 1). This makes it easy to handle and analyze the data. Furthermore, ecological information, such as food habits, nest-site preference colony size, etc., is provided to many genera (Holldobler and Wilson, 1990). Thus identifying ants to genus-level can provide useful information on environmental monitoring, conservation evaluation, and ecological research.

However, the key of Bolton (1994) is technical, and requires some knowledge of taxonomic descriptions. For non-taxonomist, a more user-friendly and pictorial identification key to ant genera is needed. Furthermore, for local inventory the regional identification key may be more convenient, because only a subset of the genera is found in each geographic region. In this chapter, therefore, a pictorial identification key to Bornean ant subfamily is provided (for genera to see "Inventory & Collection" (2002) UMS/BBEC publishing).

Before attempting to identify an ant specimen, knowledge of the specimen mounting technique and the external anatomy must be confirmed. The chapter also provides instruction of the mounting techniques and glossary of ant morphology terms.

Ants : Systematics

Ants belong to the single family Formicidae. It is related to bees and wasps in the order Hymenoptera, both belonging to the suborder Apocrita. A distinct character shared among these insects is that the first abdominal segment fuses with the metathorax forming mesosoma (in bees and wasps) or the **alitrunk** (ants). For ants the first abdominal segment that fuses with the metathorax is termed the **propodeum.** Sometimes there are spines on this part and they are called propodeal spines. The distal portion of the fused abdominal segment constricts to form the so-called petiole or waist which then articulates with the second abdominal segment. This character however, is not found in another suborder of the Hymenoptera, the Symphyta (the sawflies). One other character which relates the ants to the bees and wasps is the ovipositor which has lost its function - to deposit eggs. The ovipositor is now adapted as a **sting organ** which primarily is a defence organ. Ants are said to have evolved from wasps of the superfamily Vespoidea and they are thought to be tropical in origin.

Classically ants have been **divided into 9 subfamilies.** More recently, however, they have been reclassed into **14 extant** subfamilies. They are **Nothomymeciinae, Myrmeciinae, Ponerinae, Dorylinae, Aneuritinae, Aenictimae, Ecitoninae, Myrmicinae, Pseudomyrmecinae, Cerapachyinae, Leptanillinae, Leptandloidinae, Dolichoderinae,** and **Formicinae** (Bolton 1994). Those marked with one asterisk are endemic to Australia. Aneuxitinae, marked with two asterisks is a tropical ant found only in Sri Lanka, and is of one *genus Aneuretus.* As for Ecitoninae (marked with three asterisks), there are five genera and they are only found in South America (Ne-arctic ants). Leptanilloidinae are only found in New World tropics. The rest of the subfamilies have representation in the Orient. At BORNEENSIS - the reference centre for flora and fauna of Universiti Malaysia Sabah - these subfamilies are also represented by mostly unidentified species.

In Malaysia the largest subfamily is Myrmicinae. This is also the case globally. Smaller subfamilies includes Aenictinae and Dorylinae. The most primitive ant in Malaysia is in the subfamily Ponerinae.

The most advancd ant, in the subfamily Formicinae. Characters that indicate primitive ant include retention of ovipositor as a defence organ and pupa which is enclosed in cocoon.

Outline of Ant Diversity in Borneo

The ant fauna of Borneo Island is very diverse and unique. The island may have 9 subfamilies, 94 genera and more than 1000 described species. Worldwide, there are 16 subfamilies, about 300 genera and about 15,000 described species of ants (Bolton 1995). Thus Borneo may have representatives of about 30% of its genera and about 7% of its species, though Borneo covers less than 0.2% of the earth's land surface. The genera, including *Bregmatomyrma*, *Epelysidris*, *Ishakidris*, *Loweriella*, *Secostruma*, *Tetheamyrma*, may be endemic to Borneo. In Indo-Australian region, which include Malaysia, Philippines, Indonesia, New Guinea and Pacific Ocean islands, 22 endemic genera are found (Bolton, 1995). Thus, about 27% of them are Bornean ants.

Borneo has tropical rain forests with the richest plant diversity in the world. This is one of reason why the island has very diverse and unique ant fauna. Ant fauna in Borneo, especially in the canopy of tropical rain forests, has yet to be studied in detail. As the ant inventory are completed, many additional or new genera and species should be found from Borneo.

Functional morphological characters

In this section we are going to discuss morphological character that are unique to ants and serving one or many purposes, which may differ from other insects. Please refer to diagrams adopted from Bolton, 1994 to look for the characters mentioned in this section.

Head

One character which distinguishes ants from most other insects is the antennae. It is geniculated, meaning having an elbowed shape. The joint between the scape and the flagellum is flexible thus allowing for more movement. This is important in communication, as one mode of communication by ants is antennal contact and movements. It had been observed in ***Oecophylla smaragdina*** that when it was sent out to scout for food it would have active antennal contact with other ants when it comes back to the colony (Noraini Abdullah, 1985). If bees use the dance language, ants use antennal language - the information relayed from one individual to another by means of variable frequency of touches and intensity between antennae of the two individuals.

Twelve is the maximum number of antennal segments in ants. Some would have fewer. The least is four. Antennal sockets may be situated close to the clypeus (the posterior margin), or far from it. Antennal sockets may be exposed, especially if there are less developed frontal carinae. If the frontal carinae are well developed sometimes forming lateral emarginations, then the sockets will be fully concealed.

Many ants are polyphagous. They collect honeydew from insects - producing honeydew, by sucking through their modified mouthparts. **Tropholaxis** is a term to describe the passing of food from one individual to another through the same mouthpart used for sucking, by the process of regurgitation. Nevertheless, ants generally also have a well-developed pair of mandibles. This indicates that most ants use them for getting or processing food. Species from the ***Odontomachus*** group not only use their long **mandibles** for capturing prey but also in defence. So it is with ***Strumigenys*** and ***Myrmoteras*.** Naturally one would like to think that these are the predator group of ants. Some groups, one that was studied was ***Colobopsis puberscen,*** showed an interesting phenomen. There was a division of labour between workers and soldiers in a colony. Although general body size and shape are not very different, soldiers with heavier chitinised mandibles are recruited to assist in breaking down body parts of dead insects which are fed to the colony (Maryati & George, in prep.).

Most ants have compound eyes. However, some are blind. An example is the ***Aenictus*** with only eye patch (a faint area, maybe with some photoreceptors). These ants move in large number, bulldozing their prey from nests, underground or above ground. They are the army ants in the Malaysian tropical rain forest. Being blind has made them behave in an aggregrious manner.

Ants with very developed compound eyes include the advanced group of the subfamily Formicinae. Thus, ***Oecophylla smaragdina*** will react to any movement at a distance of about 1 meter away.

Thorax

Normally the prothorax of ants is distinguishable from the other two thoracic segments by the promesothoracic suture. However, in some species the suture is not distinct and therefore the pronotum and mesonotum are said to be fused. So is the case with the mesothorax and propodeum (fusion of metathorax and first abdominal segment).

Most ants have unsculptured thoracic segments. Some like the ***Polyrhachis*** have spines, either on the pro-, meso-, and/or the propodeum. ***Diacamma*** spp. have strong striations on the thorax. As for ***Polyrhachis*** species in the ***armata*** group, or ***Tetramorium*** spp., they may have heavily textured thorax. ***Cataulacus*** have their notum in the shape of a plate with spines. ***Meranoplus*** spp. have hairs on their thorax as well as gaster (abdomen), and these spines, heavy sculpture, and hair on the thorax suggest a defensive role.

Mesothoracic and propodeal spiracles are normally visible, their position is used in classifying some genera. Beside the position of spiracles, the position of the orifice of metapleural glands (whether exposed or concealed) is equally important.

WAIST

The posterior constricted region of the propodeum which form a waist, articulates with abdominal segment 2, normally in the shape of a node. For ant subfamilies such as Ponerinae, Dorylinae, and Formicinae the node or petiole is single. However, for the subfamilies Pseudomyrmecinae and

Myrmicinae there are two nodes, which are actually abdominal segments 2 and 3. The remaining part of the body is now known as gaster. In some genera such as ***Polyrhachis*** the petiole may be armed with spines of various length and shape. The general size and shape of these nodes, and their number can be used to recognise ant groups.

Gaster (Abdomen)

Although the general shape of the gaster is globous, there are species having a heart-shaped gaster such as the ***Crematogaster.*** There are also those with an elongated gaster such as the *Tetraponera* species. The most important feature on this body part is the function of ovipositor. In more primitive subfamilies e.g. Ponerinae the ovipositor is formed into an **exertile sting**. Sometimes is venom injected out from this structure and causing a painful sensation to the victims. Species in the genus ***Leptogenys*** have painful stings which can last for days.
In the Myrmicinae the sting is non-exertile and may not be useful. In Dolichoderinae the sting is non-functional and metathoracic gland is useful. Genus such as ***Dolichoderus*** have phenolic compounds in their glands and as such ***Dolichoderus thoracicus*** is useful as an ant species that could keep pest such as *Helopeltis theobromae,* or *Conopomorpha cramerella* at bay. ***Tapinoma*** also has an offensive, smell.

Formicinae are the most advanced ants and the sting is also non-functional. The last tergal and/or sternal sclerite may fuse to form a cone-shape structure through which formic acid from the poison gland is squirted out. This is called the **acidopore**, which is also actually the anal orifice.

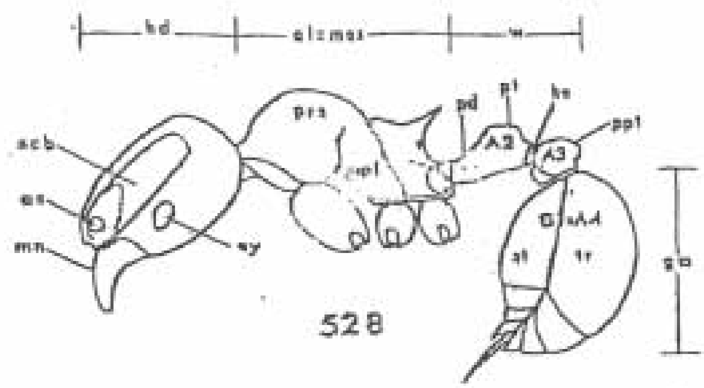
Legs and Wings

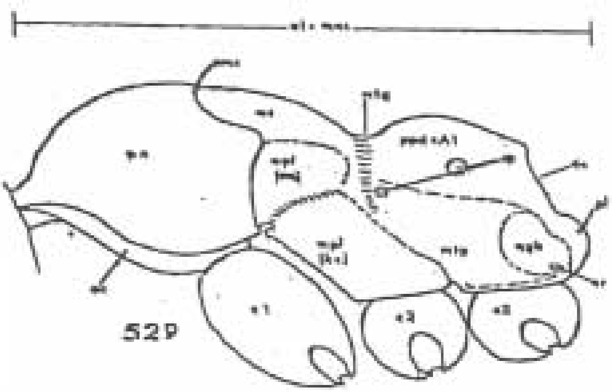
Workers and soldiers, all of which are females, are wingless. Many species of ants have winged reproductive females and males. There are also apterous reproductive females and winged males. As for the legs, most ants have relatively long legs which are slim and agile. These ensure quick movement. Length and shape of legs is determined by the behaviour of ants, whether active or sluggish. Catches made by Winkler's method when ants are not killed in the preservative ethanol, has an advantage that it shows the behaviour of ants.

Importance of ants

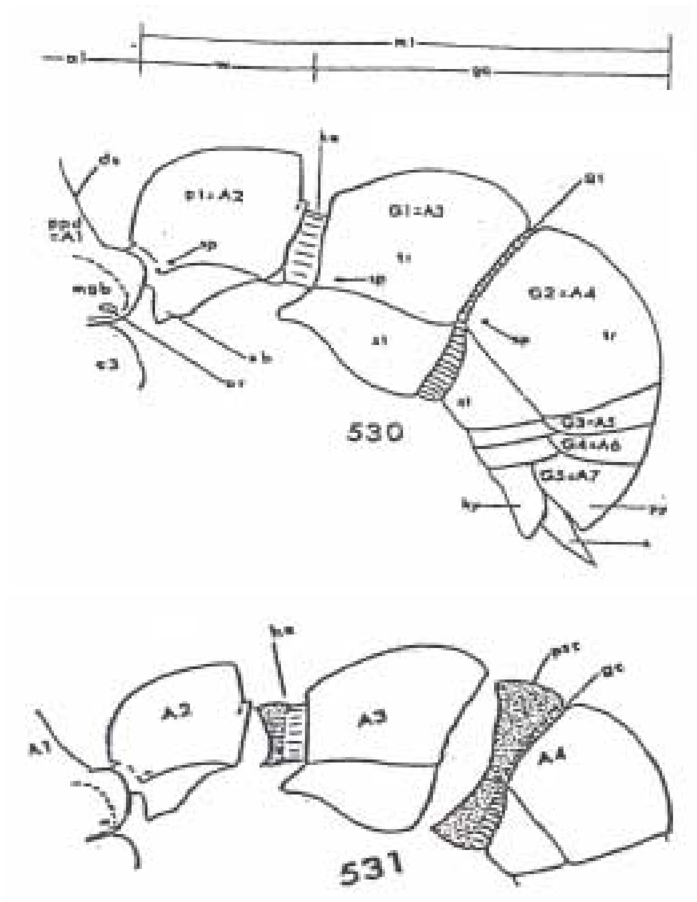
The role of ants in the forest ecosystem has much to do with the **improvement of the forest soil.** Ants, in colonies, each numbering hundreds or thousands, make nests in the forest floor. They could be nesting just under the subterranean layer or deep in the soil. Their nests vary from just a simple excavation to intricate chamber systems. These create spaces in the forest floor, thus providing some kind of **air spaces ensuring good gas exchanges for the root system** of the forest trees. In addition, these nests also make the soil more porous thus allowing for **efficient drainage** system which is a must for proper growth of plants.

Morphological characters of ants (Bolton 1994)





A	abdominal segment number
al	alitrunk
an	anepisternum
as	antennal socket
c	coxa number
de	dectivity of propodeum
ey	eye
G	gastral segment number
ga	gaster
hd	head
he	helcium
kn	katepisternum
mes	mesosoma
mgb	metapleural gland bulla
nn	mandible
mpl	mesopleuron
ms	mesonotum
mtg	metanotal groove
mtp	metapleuron
or	orifice of metapleural gland
pd	peduncle of petiole
pl	propodeal lobe
pms	promesonotal suture
pn	pronotum
ppd	propodeum
ppt	postpetiole
pr	propleuron
prs	promesonotum
pt	petiole
scb	antennal scrobe
sp	spiracle
st	sternite
tr	terfite
w	waist



A	abdominal segment number
al	altrunk
c	coxa number
de	declivity of propodeum
G	gastral segment number
ga	gaster
gc	girdling constriction
he	helcium
hy	hypopygium
mgb	metapleural gland bulla
mt	metasoma
or	orfice of metapleural gland
ppd	propodeum
psc	presclerite
pt	petiole
py	pygidium
s	sting
sb	subpetiolar process
sp	spiracle
st	sternite
tr	tergite
w	waist

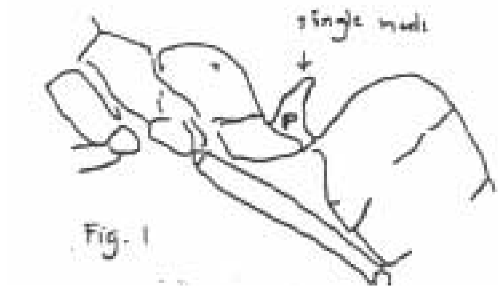
Key to the Subfamilies of Formicidae (A)

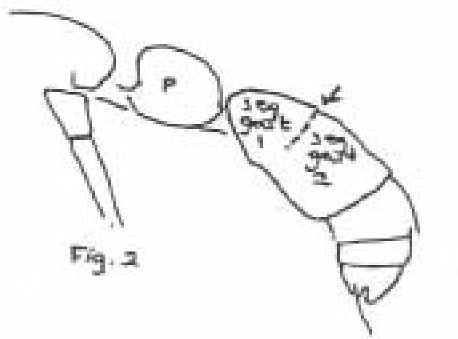
(adapted from Bolton, 1994 and illustrations from Wilson and Holldobler 1990)

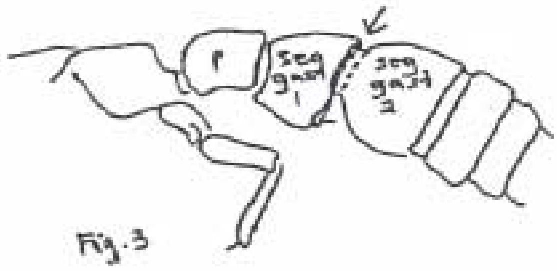
\- Promesonotal suture vestigial (fused and inflexible) to absent. Hind tibia without a pectinate apical spur; spur either simple or usually absent. Posterior margin of median portion of clypeus projecting back between antennal sockets (Fig. 29) .... **MYRMICINAE** (part)

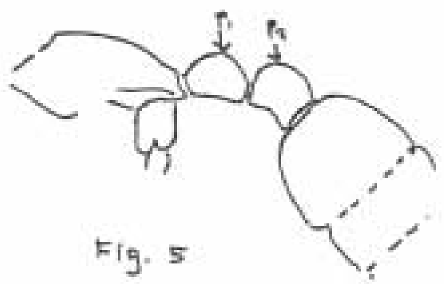
10 Promesonotal suture present and very conspicous in dorsal view; usually deeply impressed and always freely flexible in fresh specimens 11

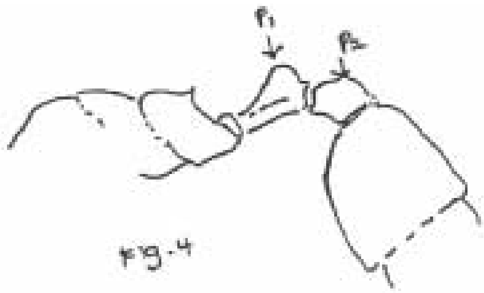
\- Promesonotal suture vestigial to absent; usually the latter but very rarely a faint transverse line is visible in dorsal view; suture never impressed nor flexible 12

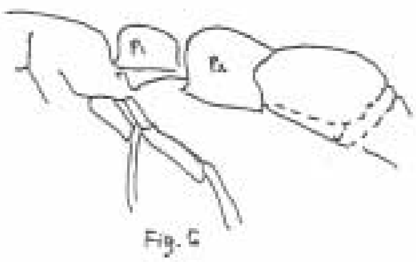










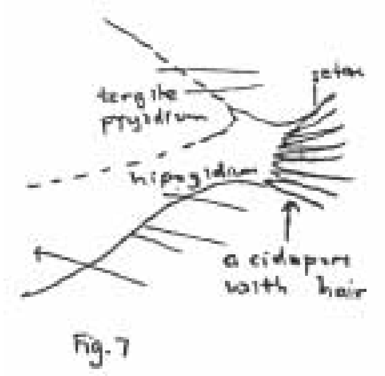


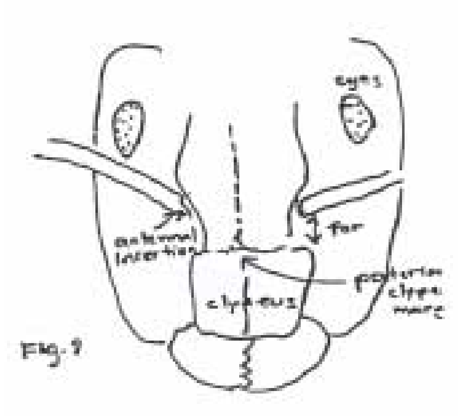
11 Pygidium large and conspicous (Fig. 30). Spiracles of gastral segements 3 and 4 concealed by preceding tergites. Sternite of helcium concealed, not visible in profile. Gaster without deep girdling constriction between the segements (Fig 31)........................... **LEPTANILLINAE**

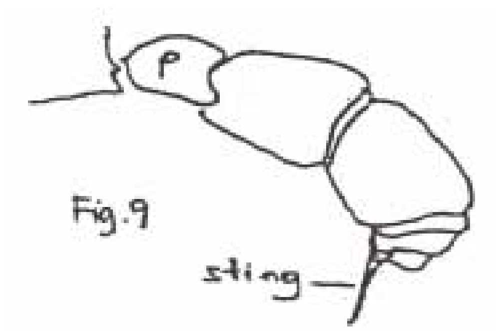
12 Antennae with 8-10 segments. Spiracles of postpetiole behind midlength of tergite (Fig. 32). Gastral spiracles circular. First gastral segment with a narrow neck-like constriction articulation with the postpetiole .... **AENICTINAE**

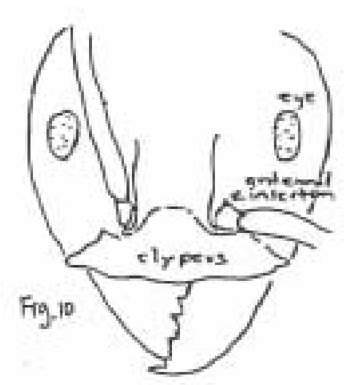
13 Promesonotal suture usually completely absent; rarely with a vestigial remnant of the suture in the form of a feeble, transversely arched impression in dorsal view, but pronotum and mesonotum always fused and immobile with respect to each other.... **MYRMICINAE** (part)

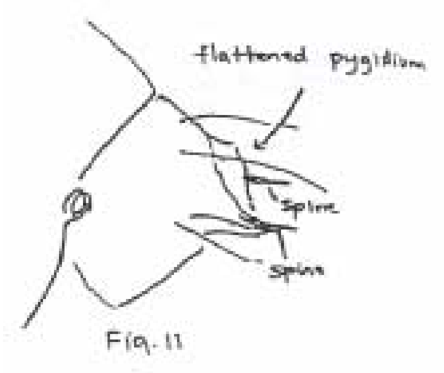
- Promesonotal suture present and very conspicous in dorsal view, the pronotum and mesonotum not fused, mobile with respect to each other .... **PSEUDOMYRMECINAE**

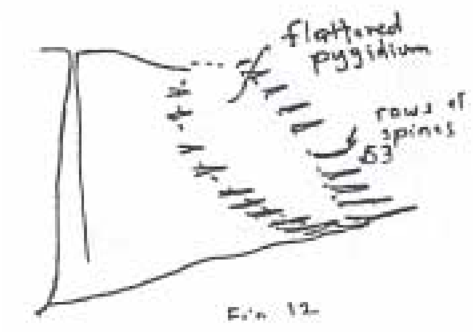




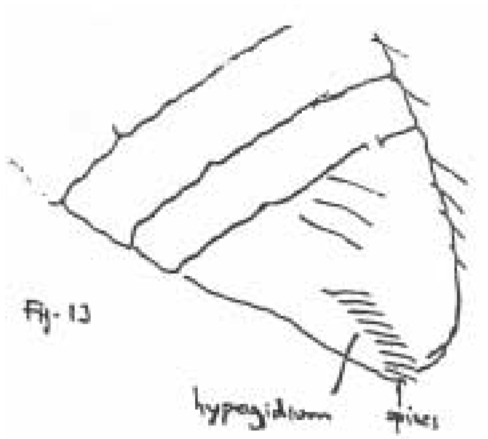






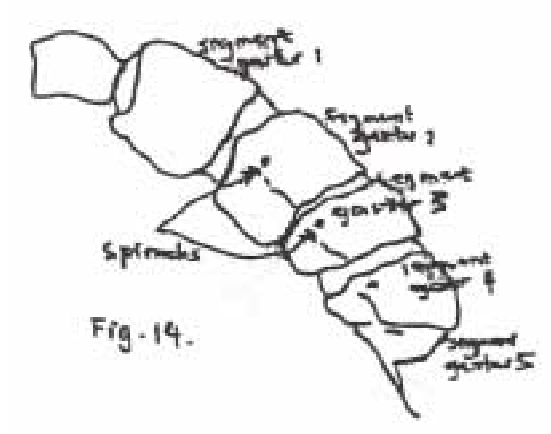


If the hypopygium is armed then its margin on either side has a row of teeth or spines, generally in the apical half, which project dorsally outside the pygidium (Fig. 13) 4

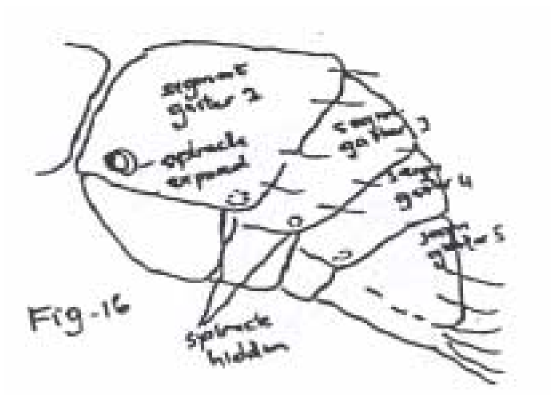


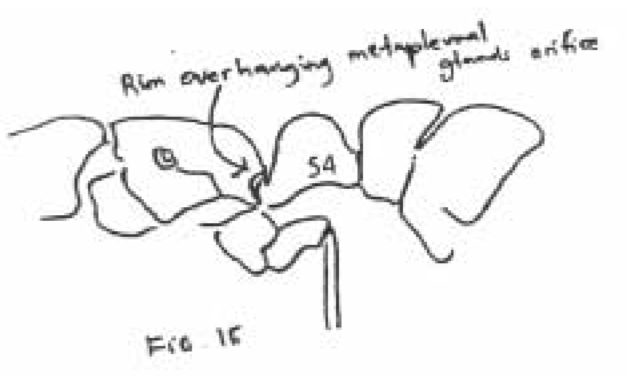
- Pygidium and hypopygium both unarmed. Pygidium transversely convex and rounded, lacking either a posterolateral pair of short spines or a marginal row of short spines or peg-like teeth. Hypopygium with its lateral margins smooth and without spines ....**DOLICHODERINAE**

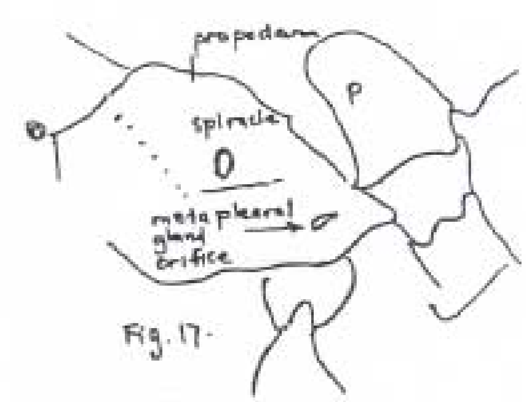
4 Gastral spiracles 3-5 (=abdominal spiracles 5-7) exposed, not overlapped or concealed by the tergites of the preceding segments (Fig 14). Metapleural gland orifice overhung and concealed from above by a cuticular lip or flange, the latter extending obliquely upwards and forwards on the metapleuron as a rim or ridge (Fig 15). Helcium sternite convex and bulging ventrally, visible in profile 5



- Gastral spiracles 3-5 (= abdominal spiracles 5-7) concealed, overlapped and hidden by the tergites of the preceding segments (Fig. 16). Metapleural gland orifice not overhung nor concealed from above by a cuticular lip or flange, and without a rim or ridge extending obliquely upwards and forwards from the gland orifice (Fig. 17). Helcium sternite reduced and retracted, not visible in profile .... **PONERINAE**





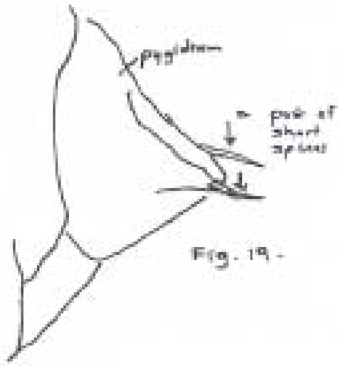


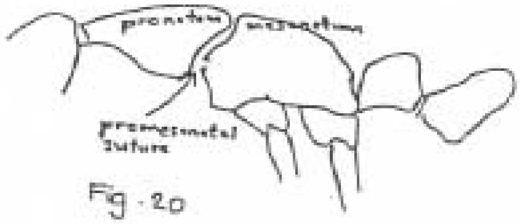
5 Propodeal spiracle high on side and situated far forward on the sclerite, the spiracular orifice subtended by a longitudinal impression (Fig 18). Propodeal lobes absent. Armament of pygidium consisting solely of a single pair of posteriorly directed short spines that are situated posteriorlaterally (Fig 19). Promesonotal suture always distinct (Fig. 20) ....**DORYLINAE**

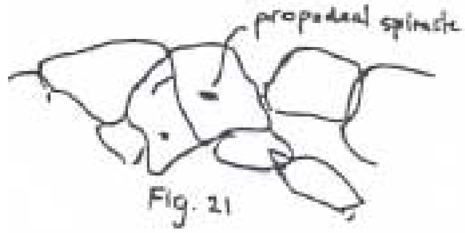
- Propodeal spiracle low on side and usually behind the mid-length of the sclerite, the spiracular orifice not subtended by a longitudinal impression (Fig. 21). Propodeal lobes present. Armament of pygidium consisting of an apical row of short peg-like teeth or spines (Fig 22). Promesonotal suture usually completely absent, only extremely rarely visible (Fig. 23) .... **CERAPACHYINAE**

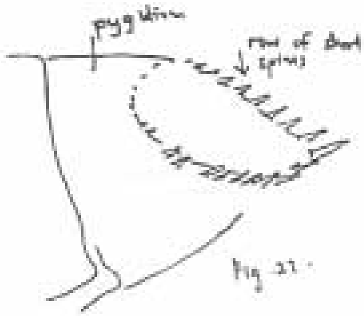
6 Pygidium transversely flattened or impressed and armed laterally, posteriorly, or both, with a row of short spines or peg-like teeth that usually project vertically (Fig 22).............**CERAPACHYINAE**

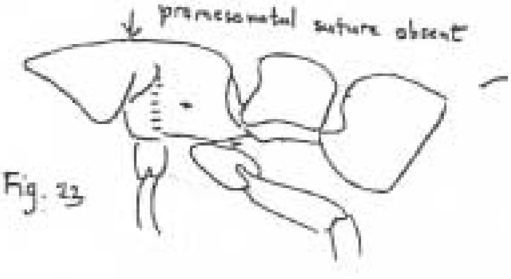
- Pygidium transversely rounded, maybe very small, not armed laterally or posteriorly with a row of short spines or peg-like teeth 7









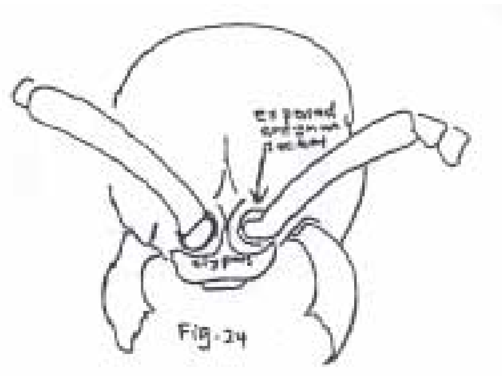


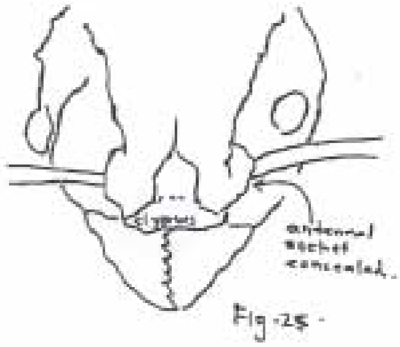
7 Frontal lobe either absent or very reduced and vertical; in either case the antennal sockets are completely exposed in full face view and are not at all concealed or covered by the frontal lobes (Fig24) 8

- Frontal lobes present, horizontal to somewhat elevated; the antennal sockets are always partially or completely covered by the fontal lobes in full-face view and are never completely exposed (Fig 25) 14

8 Eyes present and conspicous, with many distinct ommatidia (Fig 26) 9

- Eyes absent or at most represented by a single ommatidium or small featureless blister (Fig 27) 10





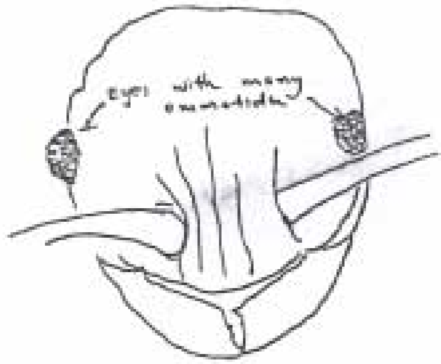


Fig. 26

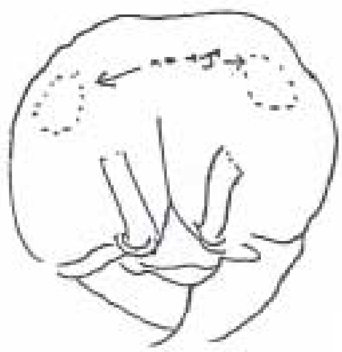
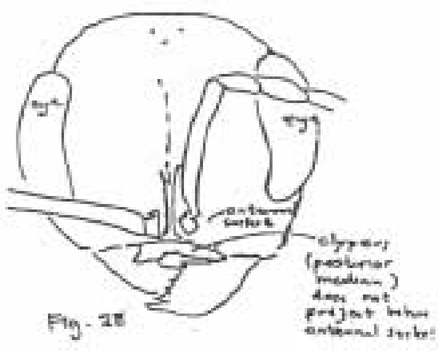
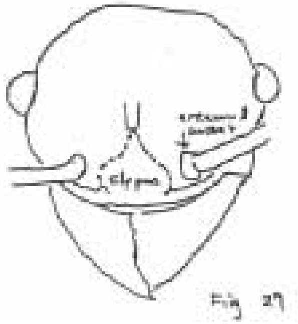


Fig. 27

9 Promesonotal suture present, freely flexible. Hind tibia with a conspicous pectinate apical spur. Posterior margin of median portion of clypeus not projecting back between antennal sockets (Fig 28) ....**PSEUDOMYRMECINAE**

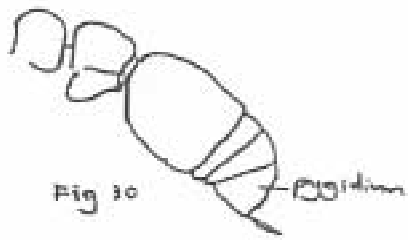


- Promesonotal suture vestigial (fused and inflexible) to absent. Hind tibia without a pectinate apical spur; spur either simple or usually absent. Posterior margin of median portion of clypeus projecting back between antennal sockets (Fig. 29) .... **MYRMICINAE** (part)

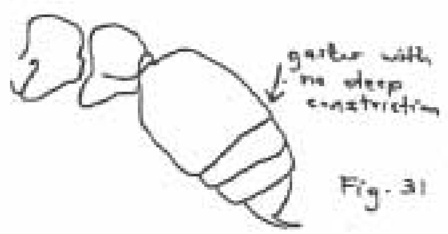


10 Promesonotal suture present and very conspicous in dorsal view; usually deeply impressed and always freely flexible in fresh specimens 11

- Promesonotal suture vestigial to absent; usually the latter but very rarely a faint transverse line is visible in dorsal view; suture never impressed nor flexible 12



11 Pygidium large and conspicous (Fig. 30). Spiracles of gastral segements 3 and 4 concealed by preceding tergites. Sternite of helcium concealed, not visible in profile. Gaster without deep girdling constriction between the segements (Fig 31)........................... **LEPTANILLINAE**



12 Antennae with 8-10 segments. Spiracles of postpetiole behind midlength of tergite (Fig. 32). Gastral spiracles circular. First gastral segment with a narrow neck-like constriction articulation with the postpetiole .... **AENICTINAE**

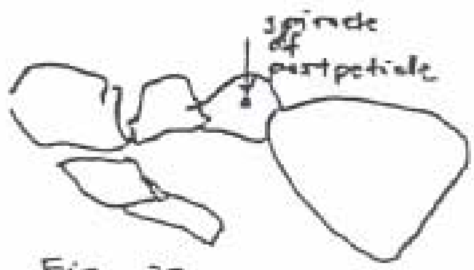


Fig. 32.

13 Promesonotal suture usually completely absent; rarely with a vestigial remnant of the suture in the form of a feeble, transversely arched impression in dorsal view, but pronotum and mesonotum always fused and immobile with respect to each other.... **MYRMICINAE** (part)

- Promesonotal suture present and very conspicous in dorsal view, the pronotum and mesonotum not fused, mobile with respect to each other .... **PSEUDOMYRMECINAE**

NOTES ON THE KEYS (ANT)
(ADAPTED FROM INVENTORY AND COLLECTION, 2003)

by
Hashimoto Yoshiaki

The keys provided here are designed to identify workers only. This is because workers are the most commonly encountered caste of ants in inventory. For sake of non-ant specialist user, I selected and easily observable characters in the keys are used. However, the use of a microscope is essential for identification of ants, because of their small size.

To make reliable identification, it is advisable to check additional information to confirm your identification. The additional information includes the diagnostic characters and biological information of taxonomic group, and the known distribution of the group. The book of Holldobler and Wilson (1990), and Social insect Web-site (http://research.amnh.org/entomology/social_insects/) can help you to search such information. This chapter also provide genus list of Bornean ants, with their taxonomic references and biological data.

In some case specimen may not identified certainly. When this happens, try to use Boltons key (1994). The illustrations provided here should help you to understand the taxonomic descriptions in the key.

PREPARATION AND PRESERVATION OF ANT SPECIMENS

The preparation of ant specimen is more important than the collection of specimen in the field. Big size organisms, like mammal and birds, can be identified in the field. However, small organisms, like ants, are needed to preserve and prepare for identification in the laboratory. The use of good preservation and preparation techniques serves to facilitate the identification of species and improves research value of specimen. Preparation and preservation techniques of ant specimens, here, are outlined.

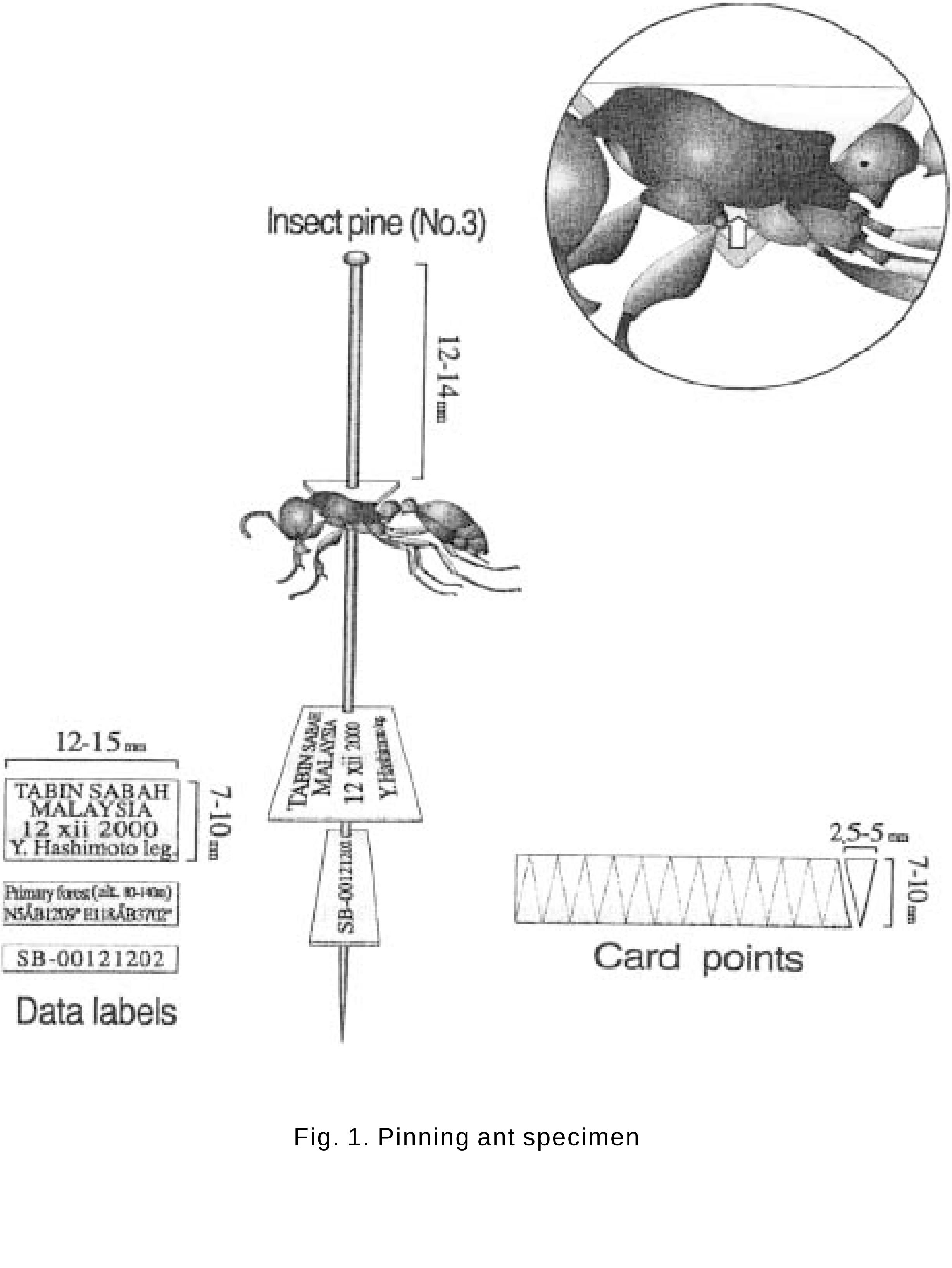


Fig. 1. Pinning ant specimen

Pinning Specimens

Insect specimens are mounted on pins so that they may be handled and examined with the greatest convenience. Therefore, for identification and taxonomic study, pinning specimens should be used. Fig. 2 shows typical tools needed to make pinning specimens.

Fig. 2. Commonly used specimen mounting tools include a pinning block, forcep, pins, points, glue

Ants are usually too small to be pinned directly, and so should be pinned as double mouths, i.e., the specimen is glued to a card point and the point is pinned through the broad end with a No. 3 insect pin (Fig. 1). Card points are slender little triangles of stiff paper, which are cut from a strip of paper (they should be no more than 10 mm long 5 mm wide). The choice of good quality paper for card points is important to prevent the specimen from working lose and rotating on the pin. To mount the specimens on card points, white glue is used commonly. Touch the tip of the point to the glue, and then the point is attached to the platform formed by the middle and hind coxae, inserting the point from the right side. Only a small amount of glue should be used, since excessive glue may obscure certain structures necessary for identification. The height of the card point on the pin will depend somewhat on specimen size, but enough of the pin should always be exposed above it to be grasped without the fingers touching and possibly damaging the specimen. Good height may be obtained by using the pinning block.

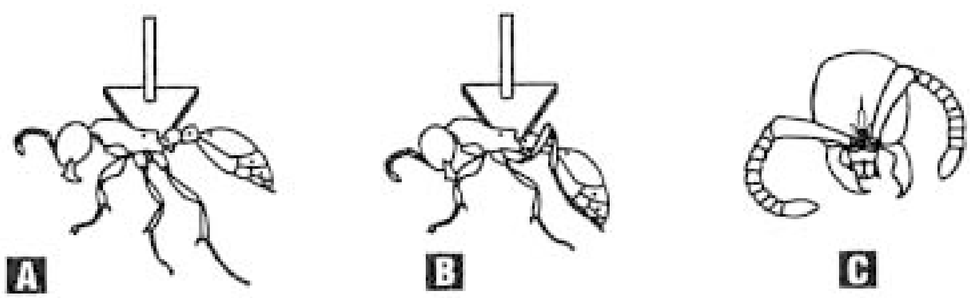


Fig. 3. Proper specimen positoning. A) Well-mounted specimen, B) Poorly-mounted specimen. C) Desirable position of antennae and mandibles

Fig. 3 illustrates some right and wrong examples for mounting specimen. In well-mounted specimen, the side of the alitrunk, the dorsal profile, and the dorsal and ventral margins of the petiole are clearly visible (Fig. 3A). Otherwise, in poorly-mounted specimen, the legs are projecting upward, obscuring the dorsal profile and the petiole (Fig. 3B). In ants, the area around the alitrunk and petiole bear many idenfication characters, and therefore the parts of the body should be free for easy examination. The head is also important area for identification. It is advisable to push upward a pair of antennae, so that they do not obscure the head (Fig. 3C). In many genera, the palp formula and mandibular dentition are diagnostic characters. One or more specimens in a series should have the mandibles opened and the mouthparts everted prior to mounting. It is somewhat troublesome and time-consuming work to make good mounted specimens. However, if any identification key is to be used with some hope of success, specimens must be mounted in the way that the characters needed for identification are clearly visible.

Labelling

Specimens without data labels have no scientific value. Therefore, during preparation and mounting, specimens should bear temporary data labels, and any time a sample is subdivided, the label must be copied so that every specimen continues to be accompanied by the data. Here, the important points for making the lables are described.

Paper and Size of Label

The paper used for making labels should be thick enough so that the labels remain flat and do not rotate loosely on the pin. Label size of insect specimen may depend on the size of the insect on a pin. An advantage of a label that exceeds the size of the insect is that if the specimen is accidentally dropped, the label may keep the insect from being damaged. However, for ant specimens, it is proper that the size should be no more than 12m long and 3mm wide (Fig. 1), because most ants are very small and large labels are incovenient to handle and examine specimen. If more data are included, more than one label should be used.

Label Printing

The style and technique of label printing or writing may vary from one worker to another. Recently, computer-generated labels printed by laser printers become increasingly common. This way has made it easier to produce labels in very small front sizes. And word processor and database software that help in generating this kind of label is widely available. However, toner of laser printer may deteriorate with age so that laser printed label will peeled off the toner finally. Methods of computer-generated labels are subject to improvement. The best labels may still be professionally printed labels.

Label Data

Collection locality, data (day, month and year), and collector name is indispensable specimen data. These data should be printed on a label (Fig. 1). Furthermore, since Global Positioning System (GPS) is available now, it is recommendable to put latitude and longitude on a label in addition to the primary locality data. For ants, information about collecting or nesting site, such as soil, leaf-letter and tree, are of great importance for identification purposes, and so usually recorded on additional labels. When a colony can be collected, it is advisable that colony code-number is assigned to the specimens belonged to the colony. This way ensures to refer combination with different castes from same colony.

Placing the Labels

The pin is inserted through the center of the right side of the label (Fig. 1), with the long axis of the label oriented in the same direction as the card point.

Wet Specimen- Liquid Preservation

In ants, liquid preservation is well used for duplication specimen storage, and also temporary storage of ant specimens, until the specimen can be mounted. Most commonly, 70-80% ethanol is used as preservation fluids. Fig. 4 shows typical tools needed to preserve wet-specimens. The specimens are kept in a small vial and then the vials are kept in a jar. Each vial should be individually labeled with complete collection data. Labels may also be placed on the outside of the jars to indicate the enclosed contents. Special care should be taken with labels for wet-specimens. Typewritten labels and laser printed labels are generally unacceptable, since such labels cannot withstand the constant exposure to the alcohol. The best may be the labels writing with soft lead pencil or Indian inks. Each vial and jar should be filled with alcohol to the top. And, the jars should be checked periodically to prevent alcohol evaporation.

Preservation for Molecular and Chematoxonomic Studies

In ants, specimens for molecular work should be collected in absolute (100%) ethyl alcohol. It is best that specimens are thoroughly dehydrated by changing the alcohol at least a couple of time before the specimens are stored for any length of time. It is also advisable to keep the specimens in refrigerator. For chemotaxonomic analysis of body-surface wax, ant specimen should be kept in less than 70% ethyl alcohol, to prevent dissolution of the was into preservation fluid.

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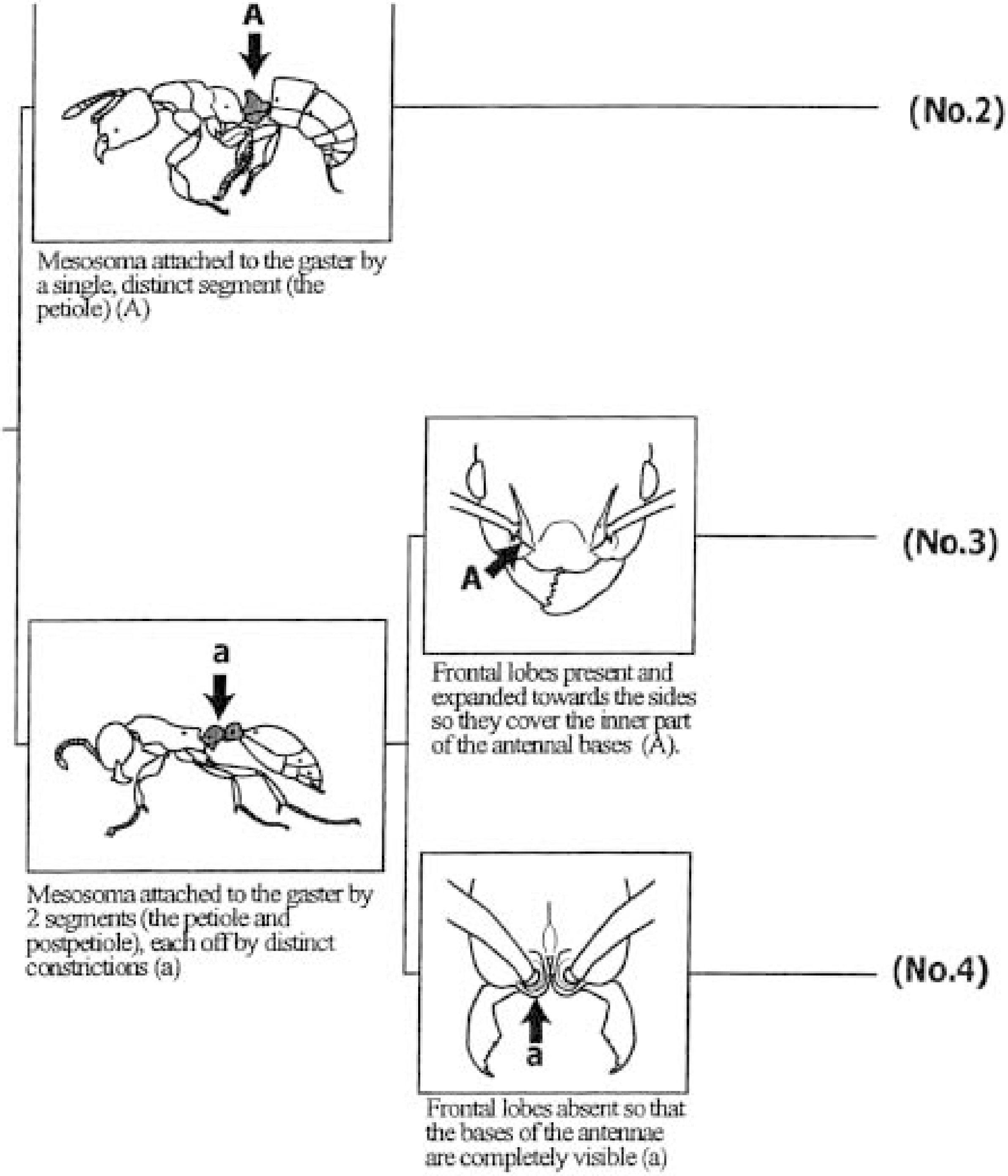
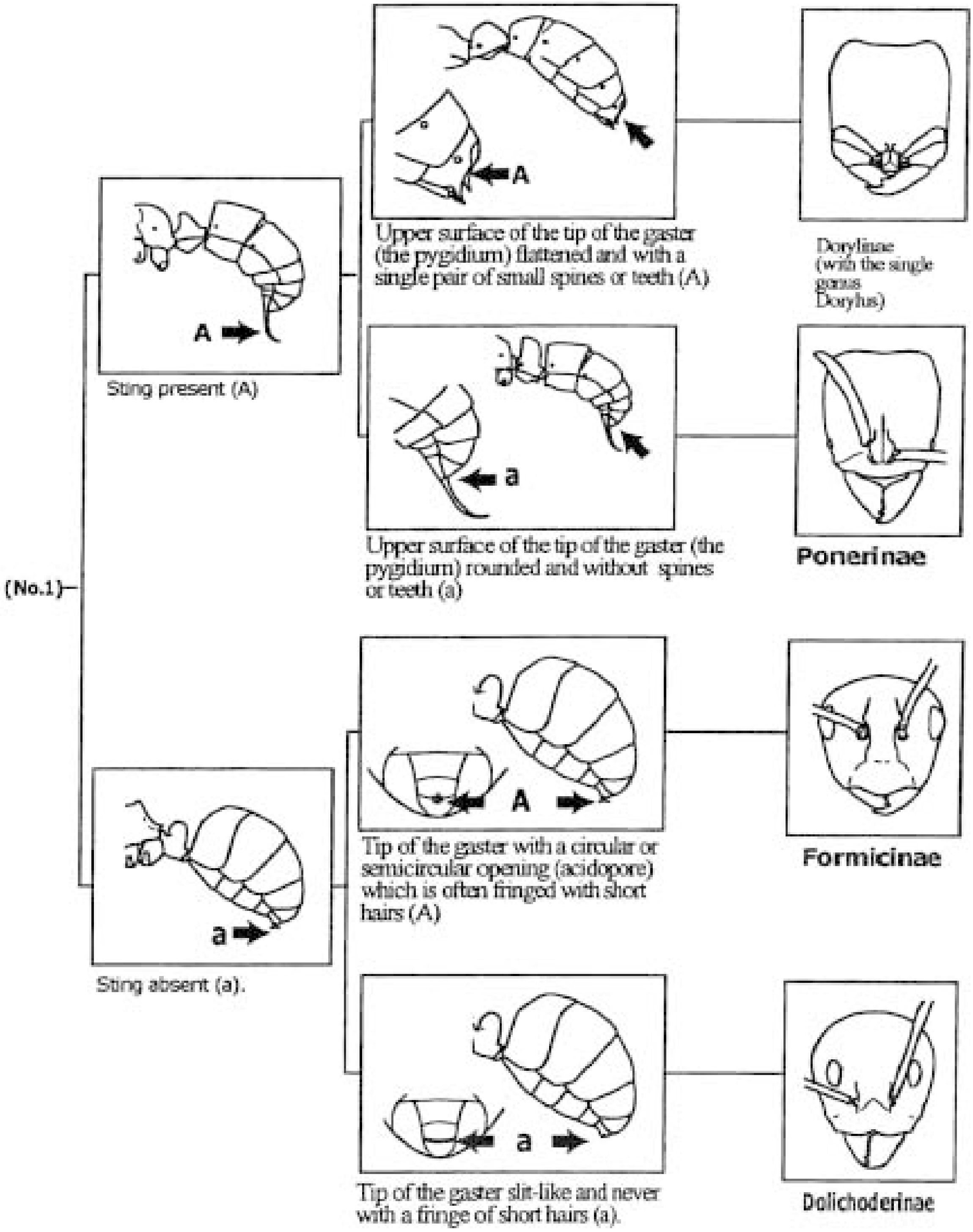
Key to Bornean Subfamily of Formicidae
(adapted from Inventory and Collection, 2003)(No. 1)

by
Hashimoto Yoshiaki



Drawing by Y. H

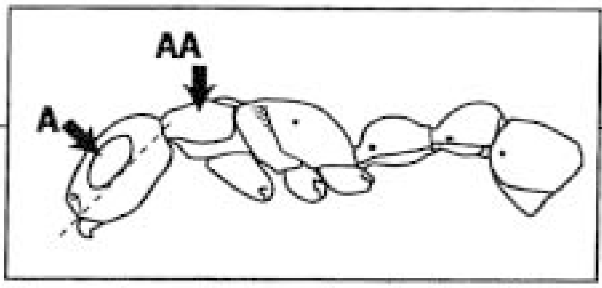
Key to Bornean Subfamily of Formicidae
(adapted from Inventory and Collection, 2003)(No. 2)



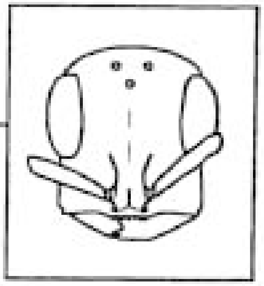
by Y. H

Key to Bornean Subfamily of Formicidae
(adapted from Inventory and Collection, 2003)(No. 3)

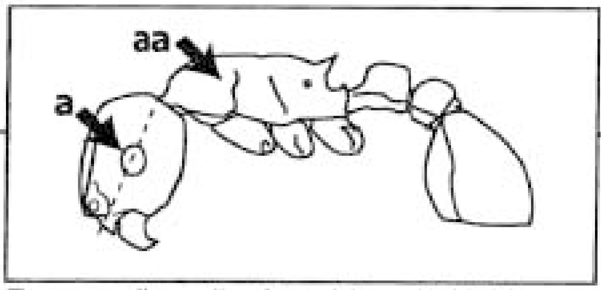
(No.1)



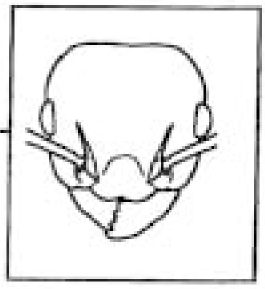
Eyes very large and elongate, located at front of the midlength of the head (A). First segment of the mesosoma (pronotum) connected to the second segment (mesonotum) by a flexible joint (AA).



Pseudomyrmecinae
(with the single genus Tetraponera)



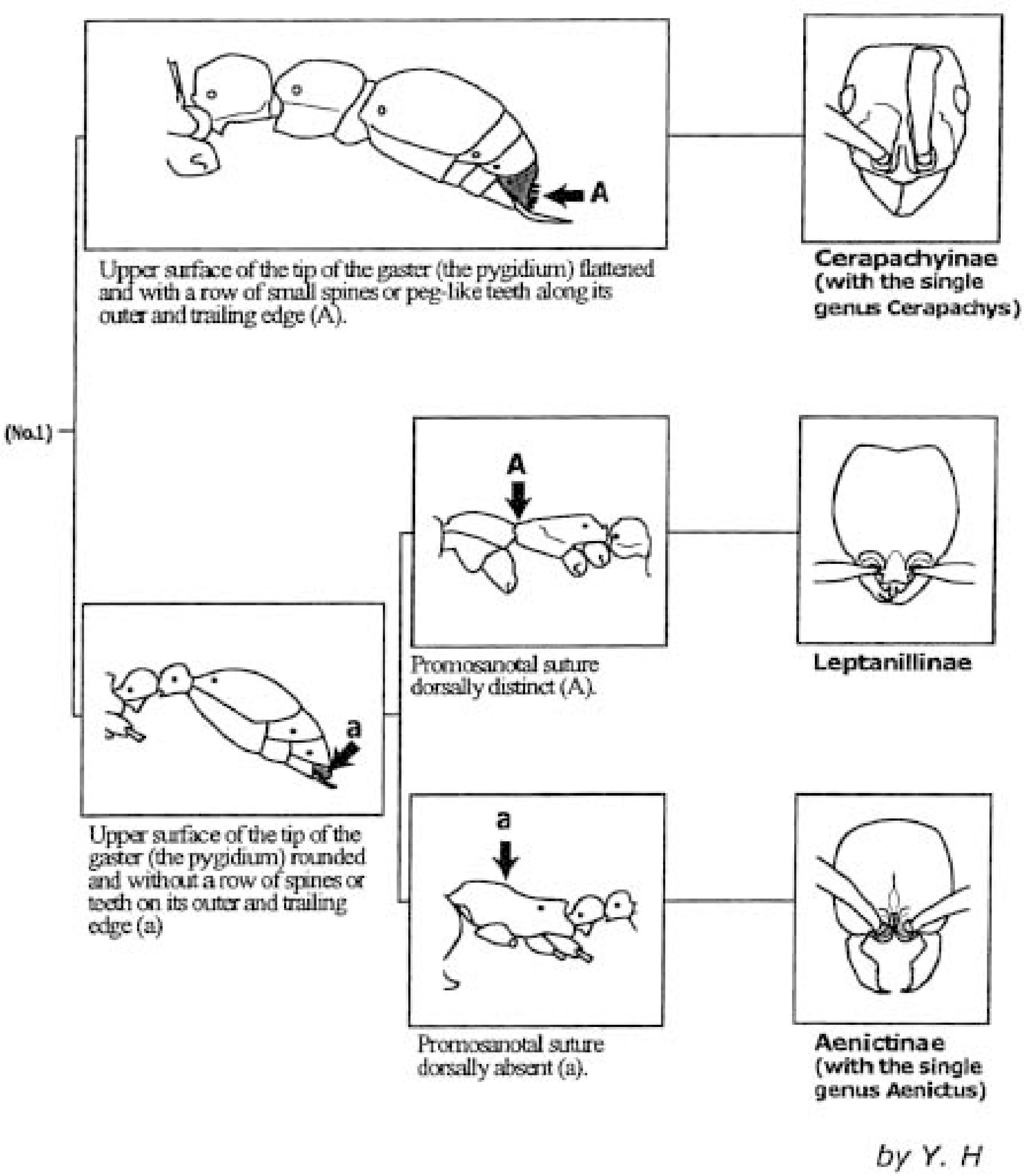
Eyes generally small and round, located behind the midlength of the head (a) . First segment of the mesosoma (pronotum) fused to the second segment (mesonotum) (aa).



Myrmicinae

by Y. H

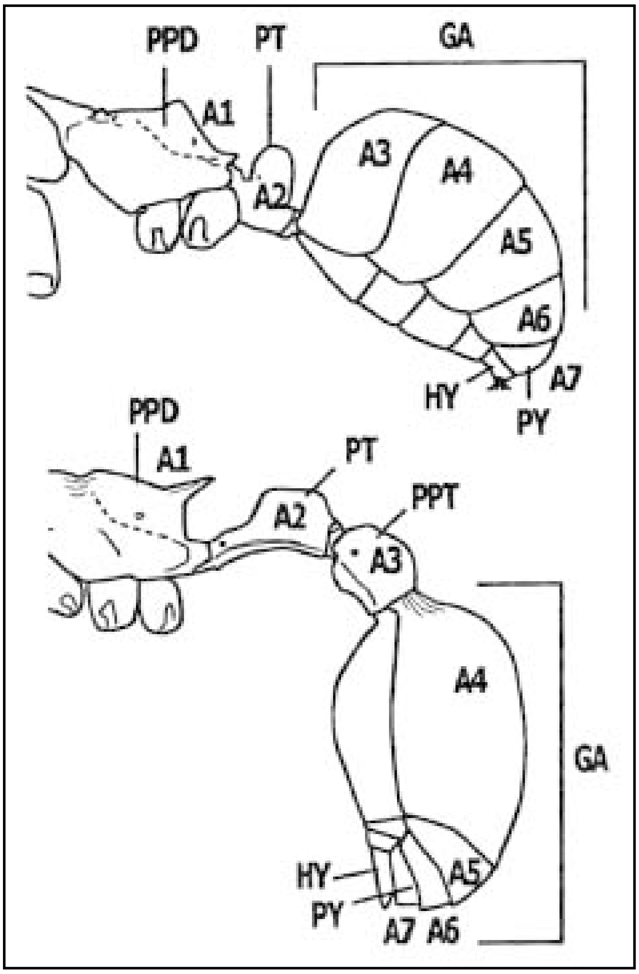
Key to Bornean Subfamily of Formicidae
(adapted from Inventory and Collection, 2003)(No. 4)



Glossary of Ant Morphology

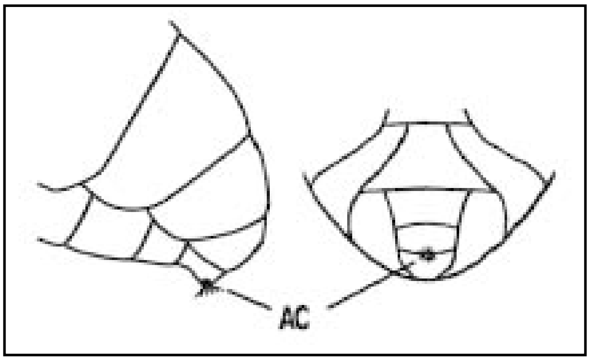
Abdomen

The abdomen in worker ants consists of seven visible segments (A1-7). The first abdominal segment is the propodeum (PPD, A1), which immovably fused to the thorax. The second abdominal segment is the petiole (PT, A2). Abdominal segment 3 is the first gastral segment when it is full-sized and broadly articulated to the following segment (A3), but when reduced and isolated it is called the postpetiole (PPT). Abdominal segment 3 or 4 through to 7 is called the gaster (GA). The last visible abdominal tergite (A7) is the pygidium (PY), and the last visible sternite is the hypopygium (HY).
See Petiole.



Acidopore (AC)

It is the orifice of the formic acid projecting system, which is formed from apex of the hypopygium, appearing a short nozzle, generally with a fringe of short setae.



Alitrunk (Mesosoma)

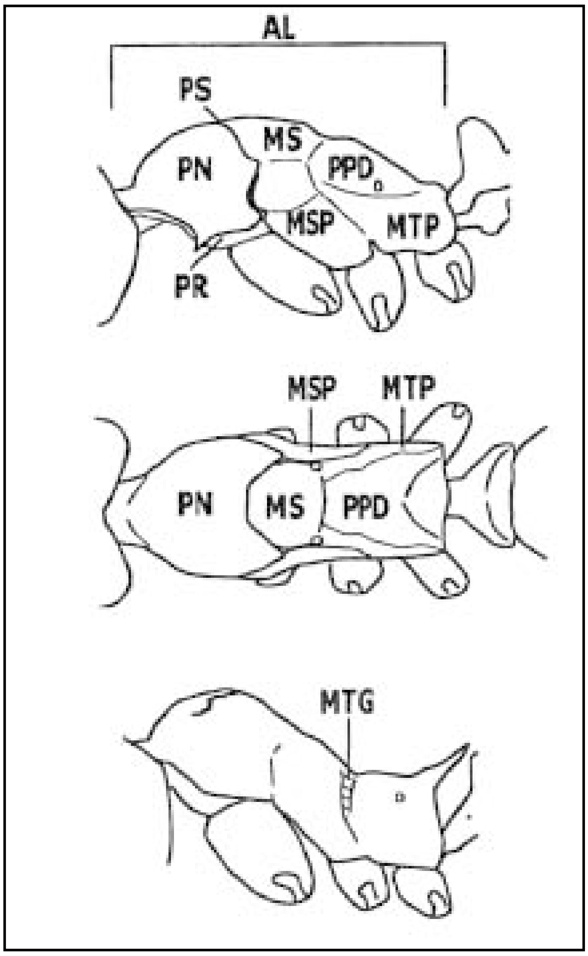
The alitrunk consists of the three segments of the true thorax (pro-, meso-, and metathorax) to which is fused the propodeum (the tergite of the first abdominal segment), to form a single unit (AL).
Pronotum (PN): The dorsal scleriteof the prothorax. In ants the pronotum extends across to dorsum and down the sides of the prothorax.
Propleuron (PR): The lateral part of the prothorax. In ants, the propleuron is concealed by the lateral part of the propleuron.
Mesonotum (MS): The dorsal part of the mescthorax. In ants, the mesonotum may be separated from the pronotum by the promesonotal suture (PMS), or may be fused to it to from a single sclerite, the promesonotum (prs).
Mesopleuron (MSP): The lateral and ventral part of the mesothorax. The mesopleuron may consist of a single sclerite or may be divided by a transverse groove into an upper and a lower part.
Metanotum (MTN): The dorsal sclerite of the metathorax. In ants, the metanotum may be reduced, or obliterated.

by Y.H

Metanotal groove (MTG): In ants, the mesonotum and propodeum are often separated by transverse groove or impression (Metanotal groove) representing the last vestige of the metanotum.

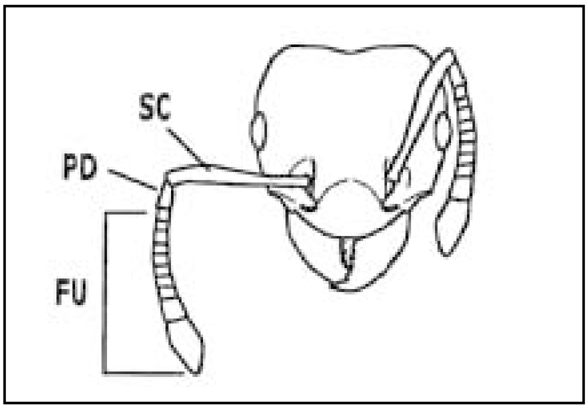
Metapleuron (MTP): The lateral and ventral part of thr metathorax. In ants, the metapleuron is located posteriorly on the side of the alitrunk, below the level of the propodeum. The metapleuron bears metapleural grand (MG).

See metapleural grand



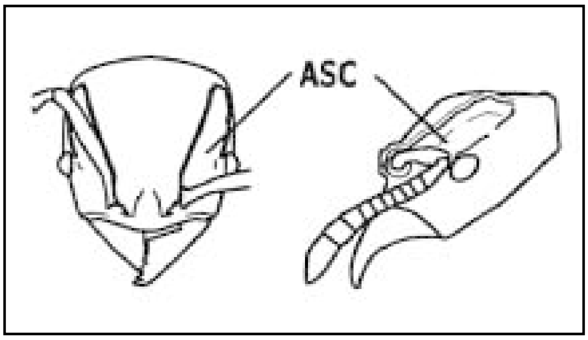
Antenna

It is a paired segmented sensory appendage of the head between the compound eyes, which consists of three parts, scape (SC), pedicel (PD) and funiculus (= flagellum, FU). The antenna in ants consists of 4-12 segments. The funicular segments may be filiform or enlarged to from a club.



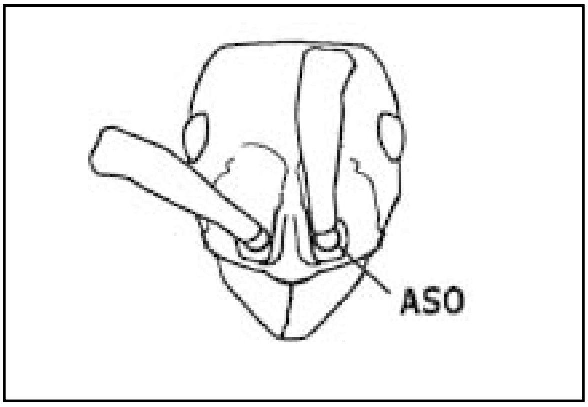
Atennal scrobe (ASC)

It is a groove, impression, or excavation in the side of the head, which runs above or below the eye, for reception of antennal scapes.



Antennal socket (insertion)

The scape articulates with the head in the antennal socket (ASO). In ants, the antennal socets usually are overhung and concealed the fronta lobe, but in some the fronta lobe absents or reduce so that they are exposed.



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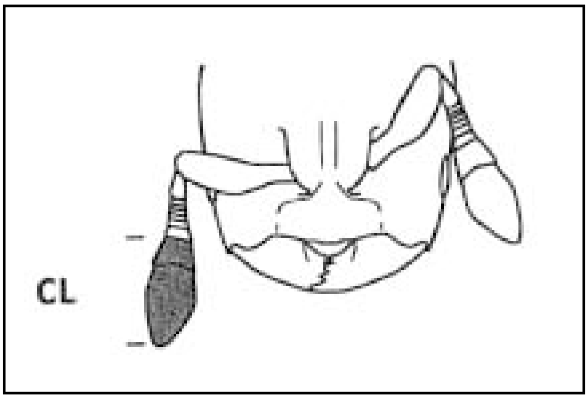
Club (CL)

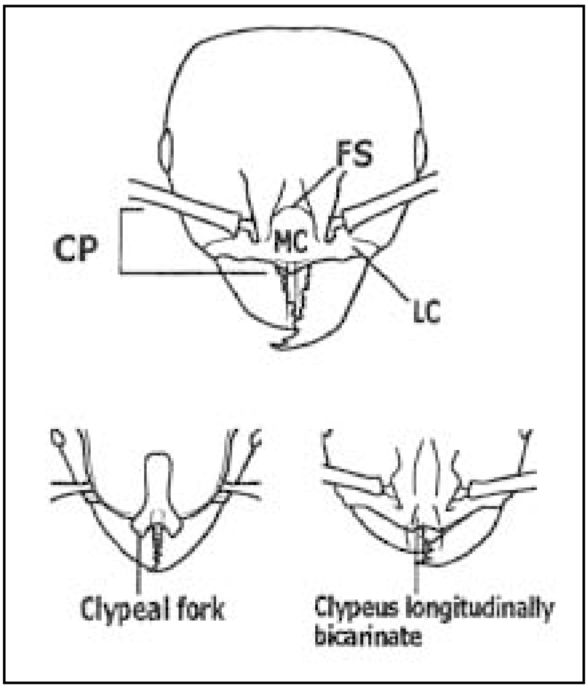
The enlarge apical funicular segments of an antenna. In ants, apical 1-4 segments may be enlarged to form a club.



Clypeus (CP)

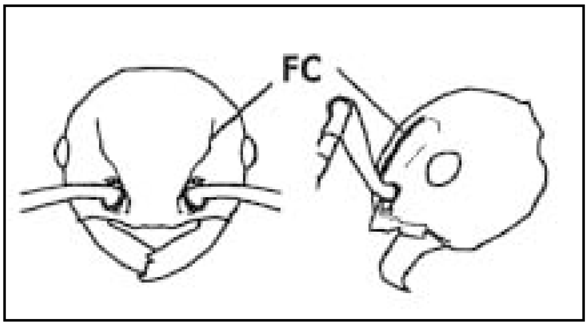
Anterior sclerite of the dorsal head, bounded posteriorly by the fronto-clypeal suture (= posterior clypeal margin or border, FS). The anterior clypeal margin usually forms the anterior margin of the head in full-face view. The body of the clypeus consists of median portion and a pair of lateral portions (MC, LC). The median portion of the clypeus may be equipped with one or more longitudinal carinae, or may be variously specialized in shape.

In some taxa the clypeus is very reduced and extremely narrow from front to back.



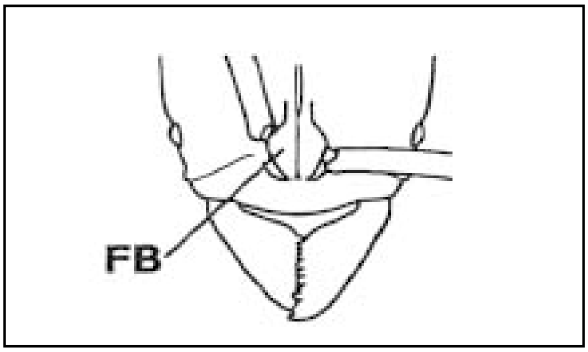
Frontal carina (FC)

A pair of longitudinal ridges on the head, located dorsally behind the clypeus and between the antennal sockets. Commonly the frontal carinae anteriorly are expanded into the frontal lobes. See Frontal lobes



Frontal lobe (FB)

The frontal lobes commonly are extensions, which partially or entirely cover and conceal the antennal sockets.

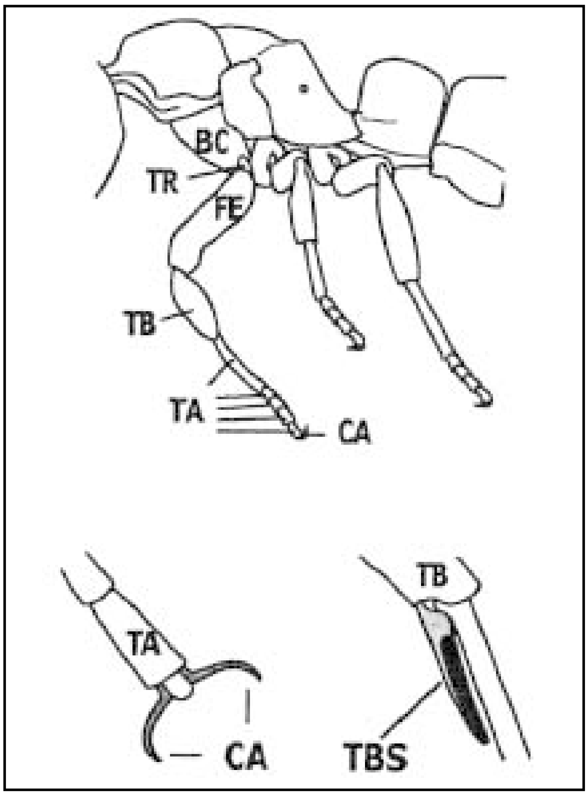


Leg segments

Each leg consists of a basal coxa (BC) that articulates with the alitrunk, followed in order by a trochanter (TR), femur (FE), a tibia (TB), and a tarsus (TA), the last consisting of five small segments and terminating apically in a pair of claws (CA).

Tibial spur (TBS) A socketed spur located at the apex of each tibia. The forelegs have a single pectinate tibial spur, modified into an antennal cleaner (strigil). The middle and hind legs may each have two, one or no spurs present.

by Y.H



Mandible (MD)

The paired, heavily sclerotized appendage of the mouthparts between the labrum and maxilla (See Mouth parts). In ants, the mandibular margins usually form a triangular or subtriangular shape in full-face view, but in some become from elongate-triangular to linear mandibles. Extremely curved mandibles, usually quite short and with few or no teeth are termed falcate.

Apical margin (= masticatory margin, MA) : In full-face view, with the mandibles closed, the apical margin forms inner margin or border of each mandibular blade, and is usually armed with teeth.

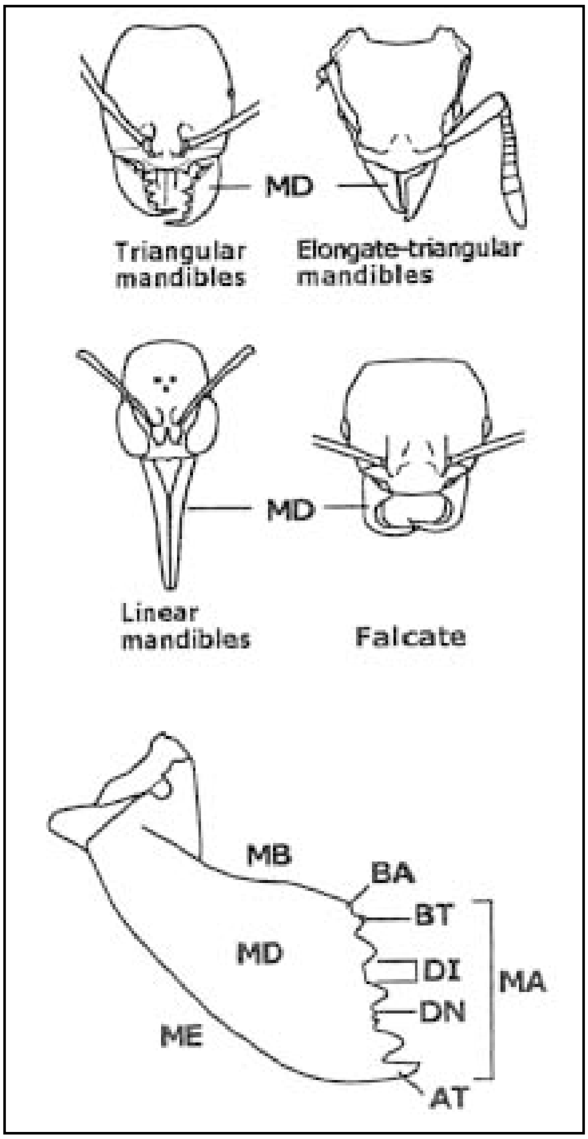
Basal margin (MB) : The basal margin of each mandible is transverse or oblique margin closet to an anterior clypeal margin. The apical and basal margins may join through a curve, or meet in an angle (Basal angle, BA). When the mandibles are narrow or linear, the basal angle may be lost. In a few taxa teeth may occur on the basal margin, but in most this margin is unarmed.

External margin (= lateral margin, ME) : The external margin of each mandible forms its outer border.

Teete (T) : Teeth are usually sharp and triangular in shape but may be rounded (crenulate), long, narrow, and spine-like (spin1form), or peg-like. The tooth at or nearest to the basal angle is the basal tooth (BT), and the distalmost tooth is apical tooth (AT). When teeth or a combiantion of teeth and denticles are present, the mandible is dentate. If only tiny denticles occur the mandible is denticulate, and if the margin lacks teeth and denticles it is edentate.

Denticles (DN) : Denticles are short or very educed acute teeth.

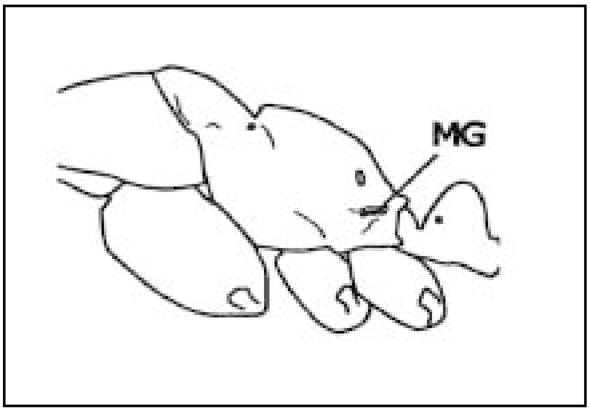
Diastema (DI) : A diastema is a gap in a row of teeth.



by Y.H

Metapleural grand (MG)

The metapleural grand is an exocrine gland whose orifice is usually situated in the posteroventral corner of the side of the alitrunk, above the level of the metacoxa and below the level of the propodeal spiracle.



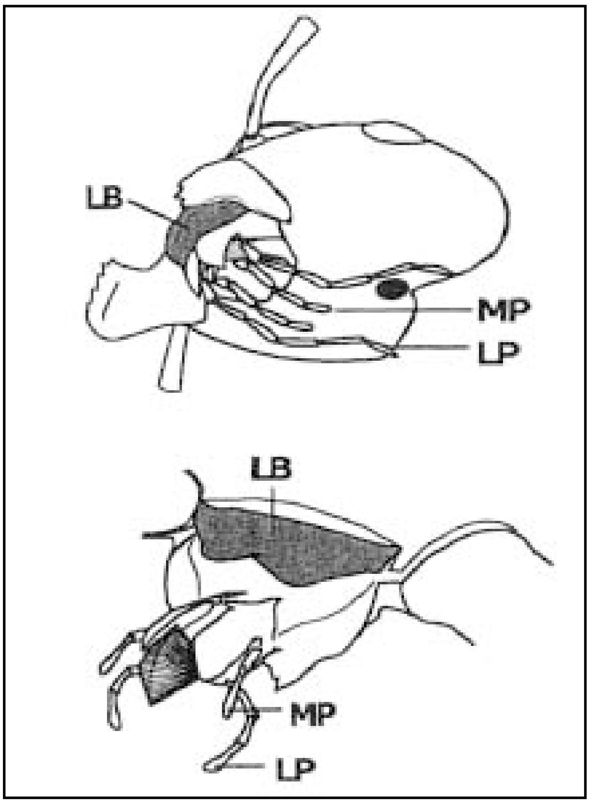
Mouthparts

The appendages of the head used for feeding, including the labrum, hypopharynx, mandibles, maxillae, and labium.

Maxillary palps (MP) : The segmented sensory palps of the maxillae. Each palp may have at most 6 segments but these are variously reduced in number in different any groups.

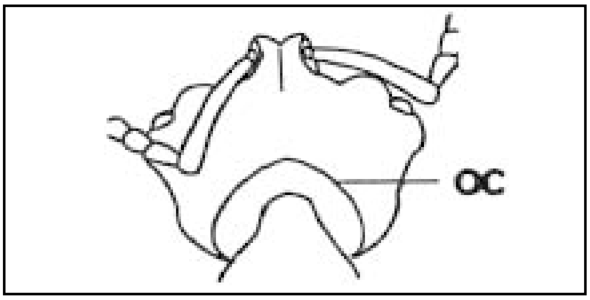
Labial palps (LP) : The segmented sensory palps of the abium. Each palp may have at most 4 segments but these are variously reduced in number in different ant groups. A way of indicating the number of segments in the maxillary and labial palps is termed as Palp Formula (PF). The number of maxillary palp segments is given first, the number of labial palp segments second.

Labrum (LB) : Mouthpart sclerite that hinges on the anterior margin of the clypeus and usually folds back and down over the apices of the maxillae and labium when the mouthparts are not in use.



Occipital carina (OC)

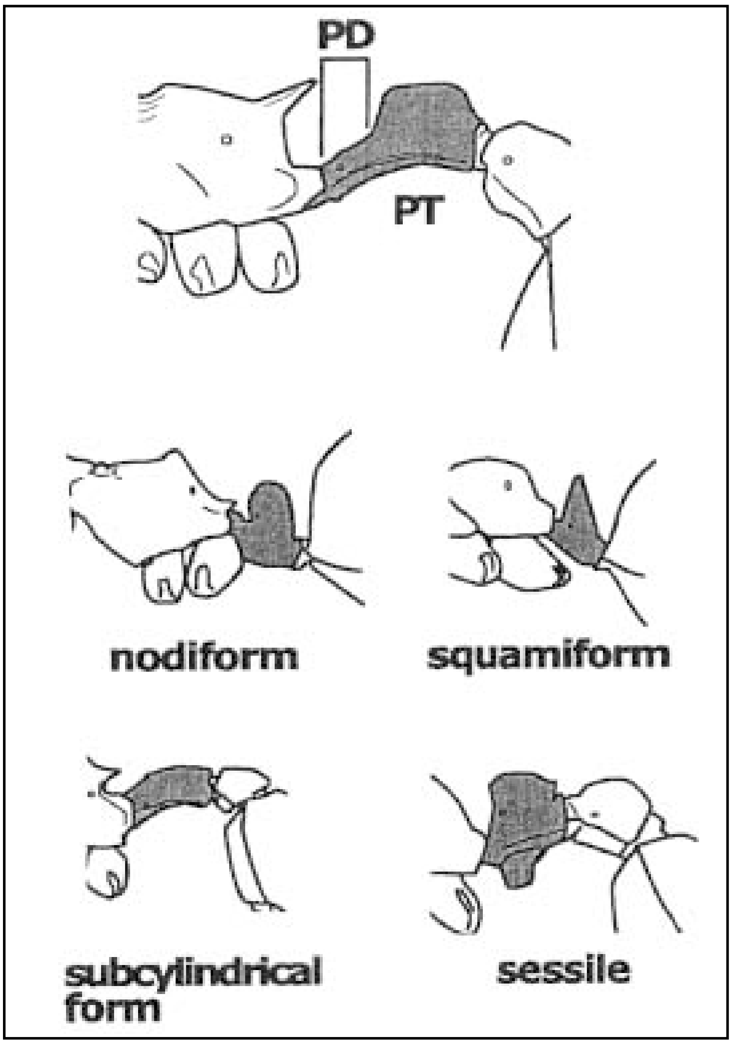
A ridge on the posterior surface of the head that separates the occiput from the vertex and gena.



Petiole (PT)

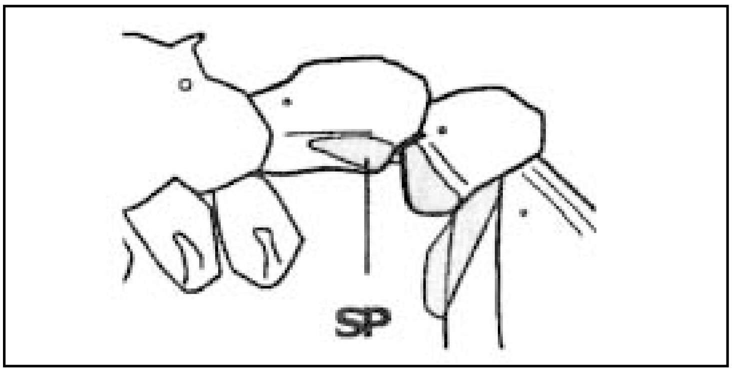
The second abdominal segment (see Abdomen). The petiole takes the form of a node (nodiform) or of a scale (squamiform), but in some taxa it may be represented by only a narrow, subcylindrical segment.

Peduncle (PD) : The relatively narrow anterior section of the petiole when the peduncle is present, the petiole is termed pedunculate. When the peduncle is absent, so that the node or scale of the petiole immediately follows the articulation with propodeum, the petiole is termed sessile.



Spongiform (SP)

Specialized sponge-like external cuticular tissue, distributed mainly about the waist segments in some groups of ants.



_by Y.H_